SCIENTIFIC AMERICAN

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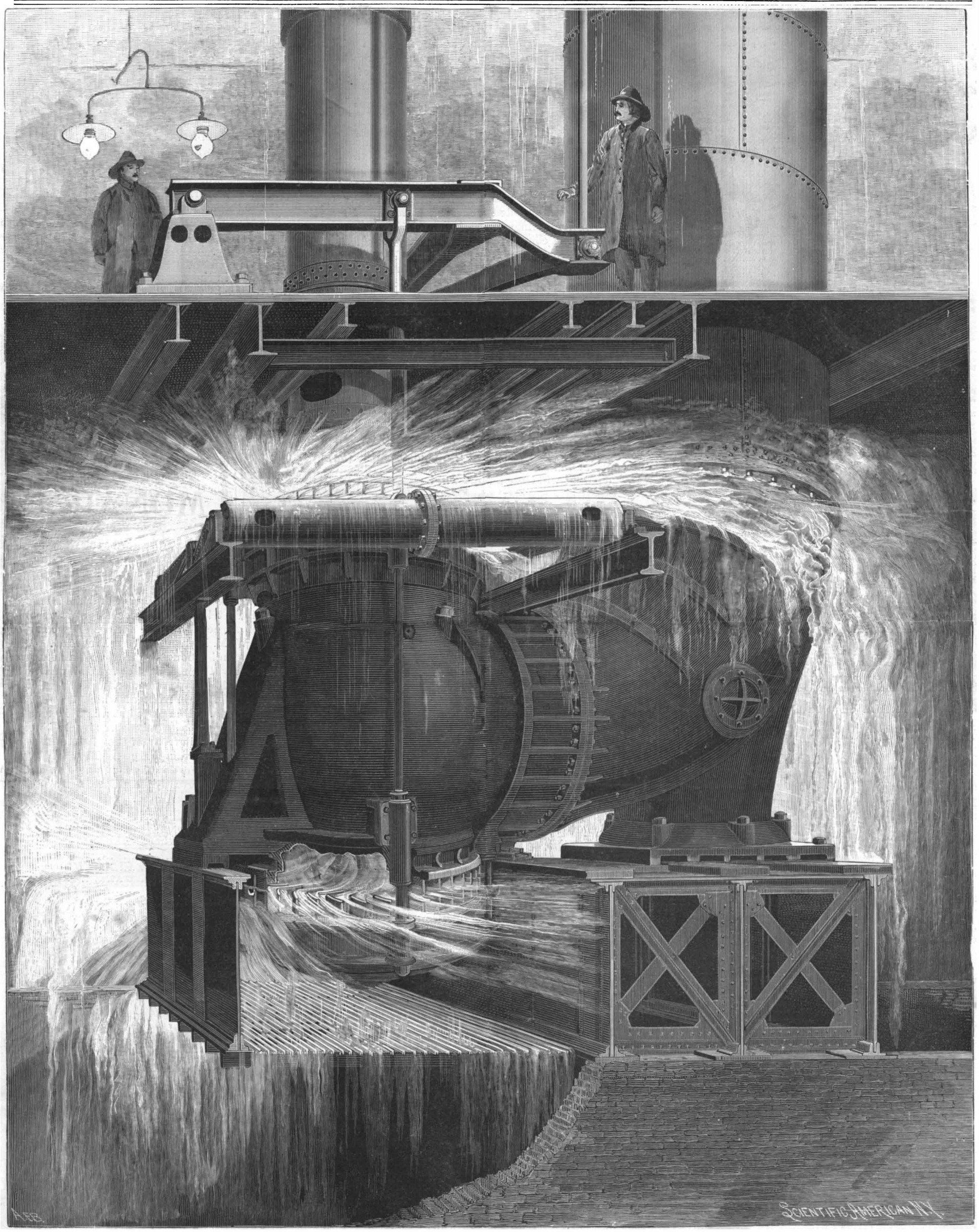

NIAGARA FALLS POWER PLANT—ONE OF THE 5,000 HORSE POWER TURBINE WHEELS.—[See page 215.]

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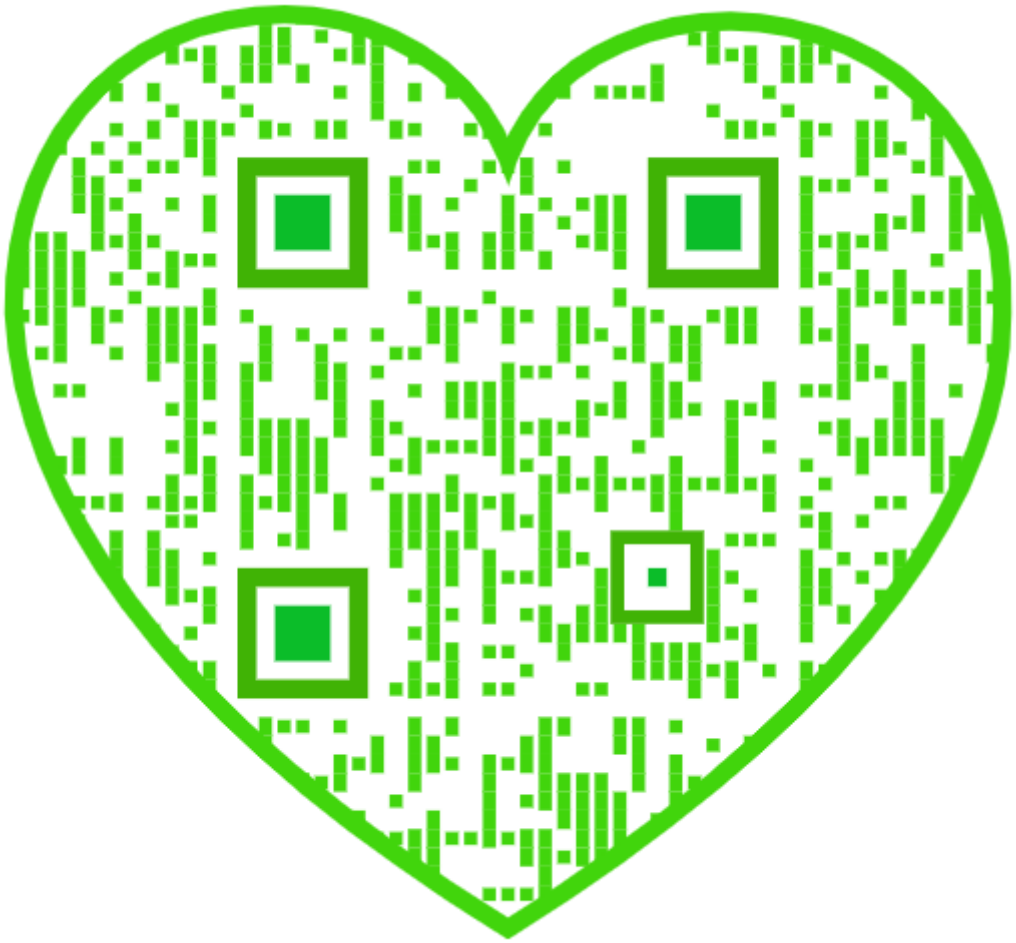

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THE VICTIMIZING OF INVENTORS.

The class of inventors has been selected by the framers of our Constitution and laws as one specially worthy of protection. The patent statutes are based on a clause of the Constitution especially providing for their encouragement, and the courts of the United States have devoted many sessions to adjudication of patent cases, the simple procuring of letters patent putting the humblest inventor in position to appeal to the highest class of Federal tribunals for the determination of his rights. The old time opinions of the judges in these cases are agreeable reading. They take the ground that the inventor requires special guardianship in his rights, the fact being recognized that the man of creative genius is often impracticable in business matters.

Unfortunately, there is another class of men who have adopted this opinion concerning inventors, and who try their best to exploit the community of patentees for their own benefit and to the accompanying detriment of their clientage. When letters patent are awarded, the drawings and claims of the patent and the inventor's name are published in the Official Gazette of the United States Patent Office. This appeals at once to a large number of sharks, calling themselves "patent agents," who see in the inventor a possible source of revenue. As soon as his patent is issued the inventor therefore begins to receive letters from various self-extolled concerns, recommending him to do various things, to apply for foreign patents, or to permit the correspondents to act as his agents for the sale of his patent on commission.

Many of these letters and circulars contain statements that are absolutely fraudulent. The inventor, for example, will be urged to apply for foreign patents in England, France and Germany and other countries, when the agent is perfectly well aware that after the patent has issued in the United States and been published in the Patent Office Gazette, valid patents cannot be procured in those countries, except under the international convention, which he is seldom able to avail himself of. The patent shark relies upon the ignorance of this fact on the part of the inventor to protect him in his nefarious traffic. He is also protected from detection by the fact that in many foreign countries there is no examination as to novelty, and, in due course, and after the payment of the government fees, the patent will issue and he will be provided with the letters patent certificate to present to his "client," who sleeps in blissful ignorance of the fact that the documents are not worth the paper they are printed on.

In many cases the fees upon examination will be found to be phenomenally low and the inventor will snap at what seems to him a bargain, simply to find that in Germany, perhaps, he has procured a Gebrauchsmuster, or model of utility patent, instead of a patent; or in Canada, he may be led to believe that he has procured a patent for one year when he has simply filed a declaration of intention, which affords no true protection.

It is after an inventor is enticed into correspondence with such firms that his troubles begin. He is probably told that his patent has been examined and found valuable, that otherwise the correspondence would never have been initiated. Perhaps he is told that the correspondent is the American representative of an "International bureau for procuring patents, with main offices in all the principal capitals of Europe," and that the foreign office has examined the patent, and has found it peculiarly well adapted for the old world.

The inventor, almost of necessity of sanguine temperament, has his hopes easily raised. His probably rather exalted idea of the merits of his invention is still further increased, and he is induced to put himself in the hands of the firm. He is then exploited to the best of the practiced ability of the "firm." He is advised to engage them as patent agents for foreign patents, and perhaps he is told that they have a purchaser for the patent, provided the inventor will take out a certain number of foreign patents. He is exhorted to invest capital if he has it, if not, to get money from his friends and to organize a company. Perhaps an alleged sale of his patent or of partial rights in it will be made and a check conveniently dated a month or more in advance will be shown him—a check which, of course, is never collected. These are no fancy sketches—precisely such lines of action are followed by numerous concerns. It has even gone so far that a similarity of name has been used to dishonestly impress the inventor with the idea that he is dealing with a firm of reputation.

The conservative patent agent who will give honest advice as to the patentability of an invention, but who will long hesitate before either approving or condemning its practical utility, and the probability of its success, is the one who can be trusted to conduct the business properly. The agent who has no conscience will urge the inventor to apply for a patent, even though he is aware that the device is not patentable.

The public is the final judge of the merit of inventions—directly or indirectly their value is settled at that tribunal—and the value of a patent can rarely be predicted with certainty. Every patent has to stand on its own merits; its exploiting must depend on the ground it covers, for a different clientele is to be reached by each invention.

The remedy for this state of things is simplicity itself: it is to be careful with whom you deal. The issuing of circulars tending to inflate the hopes of patentees is in itself a bad sign, as far as the standing of the firm issuing such circulars is concerned.

Deal only with attorneys of known integrity whose long record of service makes them well known and who have been tried and have not been found wanting.

THE LICK OBSERVATORY EXPEDITION TO OBSERVE THE TOTAL SOLAR ECLIPSE OF AUGUST, 1896, IN JAPAN.

BY DR. EDWARD S. HOLDEN.

It is proposed to send an expedition from the Lick Observatory to observe the total solar eclipse of August next in Japan. The necessary expenses of the expedition will be met from a fund provided by Col. C. F. Crocker, one of the Regents of the University of California and a member of the standing committee on the Lick Observatory.

The expedition will be under the charge of Prof. Schaeberle.

Its programme will be wholly photographic in character. Prof. Schaeberle will make large scale photographs of the corona with a lens of 40 feet focus (giving an image of the sun about $4\frac{4}{10}$ inches in diameter on a plate 18 × 20 inches) on the plan so successfully carried out by him at the Chile eclipse of April, 1893.

All difficulties in the mounting of so long-focused a lens are avoided by keeping the lens stationary and making the carriage for the sensitive plates movable. The lens is placed in the proper position for seeing the sun during totality. A large canvas tube (40 feet long) is stretched over a frame of gas pipe tubing. At the further end of this frame is an inclined railway carrying a holder for the negative plates (18 × 20). A clockwork drives the frame at the proper speed. The observer is stationed inside of his telescope, and makes the exposures according to a programme fixed beforehand. Some of the exposures will be very short, in order to obtain the finer details (only) close to the sun's edge. Others will be longer to obtain details further out, and these plates will sacrifice some of the details close to the edge, for these regions will be overexposed.

A study of all the plates obtained in this fashion will give a complete account of the whole corona, though no single plate will do so.

Mr. Charles Burckhalter, director of the Chabot Observatory, in Oakland, some time ago imagined a plan for giving the correct exposure for each part of every plate at an eclipse. He will accompany the Lick Observatory expedition to Japan and will make a trial of this plan, using a telescope of 4 inches in aperture and of 15 feet focus, specially made for the eclipse at the cost of Hon. W. M. Pierson, of San Francisco. (The image of the moon is about $1\frac{7}{10}$ inches in diameter.)

This telescope will be mounted equatorially and will follow the sun. The image of the eclipsed sun will fall on the negative plate, in front of which is a rapidly rotating diaphragm. (The plate has a hole in its center through which passes an axis driven by clockwork. On the end of the axis in front of the plate, and close to it, is a rotating fan or diaphragm.) The diaphragm is cut into the shape of a double cam, one cam being inverted, so that it is perfectly in balance, and it makes about five revolutions per second.

One of the double cams has such an outline that if the corona at the moon's edge has an exposure of one second, the exposures elsewhere will be:

At 26′ from the edge	4 seconds.
" 46′ " " "	9 "
" 66′ " " "	14 "
" 86′ " " "	20 "
" 108′ " " "	24 "

Other differently shaped cams are provided, each ready for operation, with its clock, in its special plate holder. When the plate holder is lifted, the clock starts automatically and runs for about 15 minutes. Five or six such plates will be exposed during totality. Each plate will be exposed much longer at the outer limits of the corona (where the light is weakest) than at the inner limit (where the light is strongest). It is therefore hoped to secure, in this way, a photograph of the corona on a single plate, every part of which has received the proper exposure. This single plate will then exhibit all the details of the corona, and it will no longer be necessary to build up, as it were, the real corona from a series of plates (each one of which is underexposed for one region, overexposed for another, and correctly timed for another).

Mr. Burckhalter's ingenious plan deserves a trial. The only difficulties in the way are mechanical ones, and these are now supposed to be conquered.

Besides the 40 foot lens Prof. Schaeberle will take with him a 5 inch photographic refractor (presented to the Lick Observatory by Miss Floyd) and a Dallmeyer portrait lens of 6 inches aperture (lent by Hon. W. M. Pierson).

The former instrument will be used to make small

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scale photographs (on 5 × 7 plates) of the corona and surrounding stars (and possibly comets); and at least two of these plates will be impressed with squares of 1s, 2s, 4s, 8s, 16s, exposure from a standard lamp before they are exposed to the light of the corona. When they are developed, the squares of standard intensity will appear at the same time with the image of the corona, and a photometric measure of the brightness of the latter is thus possible, in terms of the brightness of the standard lamp. This plan (first carried out by the Harvard College Observatory) has been followed at all the eclipses observed by Lick Observatory parties, viz., January, 1889; December, 1889; and April, 1893.

The portrait lens will serve to register the extension of the corona and a wide field of stars (and any possible new planet).

Messrs. G. E. Shuey and Louis C. Masten will go with the party as volunteer assistants and will be in charge of the smaller instruments. Prof. H. Terao, director of the Imperial Observatory of Tokyo, has kindly offered to select a member of the staff of his observatory to accompany the Lick Observatory expedition, as one of its members.

The Hon. Secretary of State, the United States Minister and Consul-General in Japan will do all in their power to forward our plans. It is to be hoped that the expedition may meet with good weather and return with results which will reward its labors.

THE MANUFACTURE OF PAPER.

Prominent among the greater industries of the United States, which have grown to large proportions during the past twenty-five years, is that which is devoted to the manufacture of paper. At a recent meeting of the American Paper Manufacturers' Association the president stated that the association was formed about eighteen years ago, and that the paper business had since taken on a rapid growth. At that time the manufacture of paper in the United States had grown to such an extent after the war that the capacity of the mills in 1878 in the production of paper amounted to nearly 3,000 tons of product per day. To-day the capacity of the mill product in this country is about 12,000 tons per day.

The general public has little idea of the size and cost of an average paper mill. The finished product, as we see it in our books and our daily newspaper, is so familiar, and the materials of which it is popularly supposed to be made are so cheap, and for most other purposes worthless, that to many it will be a surprise to learn that an average paper mill costs from $1,000,000 to $3,000,000 to build and equip. It is capable of turning out some 40 tons of paper per day, and to run the machinery requires boilers and engines of not less than 3,000 horse power. For washing the pulp, etc., there will be required 4,000,000 gallons of water per day, or enough to supply a city of 50,000 inhabitants, and the whole of that supply must be filtered by the most approved modern processes.

The manufacture of the paper may be broadly separated into two processes, consisting, first, in the preparation of the pulp, and secondly, in the formation of the paper from the pulp.

I. The Preparation of the Pulp.—The popular idea that paper is made from rags is true only of fine writing paper, which is made entirely from this material; but newspapers and most book papers are made entirely from wood. The better class of book paper is made from wood and a small percentage of rag. There are two kinds of wood pulp.

1. Ground or Mechanical Wood Pulp.—This is made by grinding the ends of spruce wood logs against revolving emery wheels. This is done under water, and the result is a finely divided wet sawdust. The wood retains all its natural gums and acids and has no fiber. It must be used with some more fibrous material, such as chemical wood pulp. This is the cheapest form of pulp, and it is therefore only used for newspapers and so-called manila wrappings.

2. Chemical Wood Pulp is made from spruce or poplar. The timber comes to the mill in barked logs, which are four feet long, and have had all the knots carefully bored out. The logs are fed into a "chipper," in which the knives are arranged at an angle of 45 degrees to the center line of the machine. These knives cut the logs diagonally to the grain into "chips" which are half an inch long. The chips are conveyed to "digesters," which are upright cylinders 7 or 8 feet in diameter and 30 feet long. If spruce wood chips are being used, they are treated by the acid process, the digesters being lined with acidproof brick. The acid liquor is obtained by mechanically combining sulphurous acid gas with milk of lime, and forming a bisulphite of lime. The digesters are filled with chips and liquor in proper proportions, and are then hermetically sealed. Live steam is introduced, and the chips are boiled for eight hours under a pressure of 110 pounds to the square inch.

If the chips are made from poplar, the process is the same, except that the liquid is made from caustic soda ash and water.

After the boiling is completed, the contents of the digesters are blown out into a receiver, where it presents the appearance of a mass of soft pulp. The liquor is then washed out; and after the pulp has been bleached, it so closely resembles the rag pulp, which is used in the manufacture of fine book paper and writing paper, that only an expert can tell the difference, both being a pure vegetable cellulose. The pulp is now subjected to a process of beating and macerating, to reduce it to the proper consistency; and at this stage coloring may be added to give any desired shade. A certain amount of sizing is also introduced—the sizing being made from resin "cut" with soda ash—for the purpose of giving impermeability to moisture and a firm surface; otherwise the product would be a simple blotting paper.

The pulp is now ready to go to the paper machine. It should be noted here that newspaper pulp is formed of 80 per cent ground pulp and 20 per cent chemical pulp. Book paper is formed entirely of chemical pulp.

II. The Paper Machine.—If he bear in mind the frail nature of the article which it is designed to handle, the visitor to a paper mill will be astonished at the great size and weight and the massive strength of a paper mill.

At first sight, the massive cast iron and steel frame, from eight to ten feet wide, and from one hundred and fifty to one hundred and seventy-five feet long, appears to be better fitted to manufacture iron and steel than to handle the thin, milky fluid which stands ready for manipulation at the upper end of the machine. The wet pulp, of which 95 per cent is water, first passes through a screen, where it is cleaned. It then flows into a vat, at the further edge of which is provided an outflow, which consists of a true, level, edge or lip which forms a kind of weir, over which a broad, thin stream of pulp flows onto the paper machine proper. This stream is the full width of the machine, and its depth has to be kept perfectly true and even throughout. The pulp falls onto what is known as the Fourdrinier wire. This is an endless wire cloth, seventy meshes to the inch, which is the full width of the machine, and travels continuously over a set of parallel rolls, passing around an end "couch roll," and returning again under the machine. In addition to its forward motion, this wire cloth or screen has a lateral rocking motion across the machine. As the pulp flows onto this wire a large portion of the water, assisted by the shaking, strains through and passes away, leaving a thin film of pulp, which is the future sheet of paper. This film is picked up off the "couch roll" by an endless woolen felt, which carries the wet sheet between several gun metal "squeeze rolls" or "press rods," which force out a sufficient amount of water for the sheet to be able to sustain its own weight.

At this point the sheet is transferred to an endless cotton felt, which supports it while they both pass over and around a dozen or more driers, which are hol low cylinders 3 feet in diameter and extending the full width of the machine, through which a constant flow of live steam is maintained. These thoroughly dry out the paper.

At this stage of the process the sheet is rough and uneven, presenting very much the appearance of a sheet of paper that has been wetted and allowed to dry out again. It now has to be ironed out, as it were, and the desired finish imparted to its surface. For this purpose it is passed through the calenders, which consist of two vertical standards which carry usually 11 superimposed chilled steel rolls of the very highest possible polish. The paper is inserted between the upper two and passes down through the whole set, the desired pressure being obtained by means of powerful screws. This process is repeated in a second stack of rolls, after which the finished paper is wound into a large roll. It is then passed through the cutters and cut to the required width and length.

If a highly finished surface is desired, the paper is passed through what are known as super-calenders, which consist of 7 rolls, 4 of chilled steel and 4 of pressed paper, arranged alternately, the combination of the two materials in the rolls giving a high finish. The whole machine is run at a very high speed, 300 to 350 feet per minute being common. There are some machines that run the paper out at the rate of 400 feet per minute, or between 4 and 5 miles per hour, and such a machine will frequently run an entire day without a break in the paper.

These speeds are only possible in the manufacture of common news paper. In making the finer grade of paper, with high finish, such for instance as is used for the SCIENTIFIC AMERICAN, the mill can only be run at about one-half the above speed.

The whole machine has to be adjusted with the greatest care and nicety. It runs at so high a speed, and the material upon which it operates is so frail, that any unevenness in the rolls, or an irregularity in the speed of any particular part of the machine, would break the sheet, and throw the work into confusion.

The following material is consumed every month in a paper mill of 40 tons per day, or 1,000 tons per month capacity:

Coal	15 tons.
Wood	2,432 cords.
Bleaching powder (chloride of lime)	142 tons.
Sulphur	77 "
Lime (milk of lime)	57 "
Resin (sizing)	17½ "
Soda ash	125 "
English clay	200 "

Many a paper mill is run continuously from 12 P. M. Sunday night until 12 P. M. on the next Saturday, two sets of operatives being employed. From the time the log of wood is put into the chipper to the time the paper is cut up into sheets, the material is never handled, but passes through a continuous mechanical process.

Obituary.

DEATH OF GENERAL CASEY.

Brigadier-General Thomas Lincoln Casey (retired), late Chief of Engineers, United States Army, died at his residence in Washington, on March 25. General Casey was the son and grandson of soldiers. His father was General Silas Casey. General T. L. Casey was born at Madison Barracks, Sackett's Harbor, N. Y., in 1831. In 1848 he received an appointment to the United States Military Academy. Four years later he graduated at the head of his class. He entered the engineer corps as second lieutenant in 1852. He was assigned to duty in connection with works of improvement on the Delaware River and Bay. When the civil war broke out he was sent to New England, as superintending engineer of the permanent defenses and field fortifications on the coast of Maine. In March, 1865, he was breveted lieutenant-colonel for faithful and meritorious services during the war. He was then appointed superintending engineer of public buildings and grounds for the District of Columbia. He had charge of the Potomac Aqueduct, and to him also was committed the completion of the State War and Navy Department building, in Washington, the Washington Monument and the construction of the Medical Museum and Library. He was president of the Board of Engineers for fortifications and other public works at New York from 1886 to 1888, when he was appointed brigadier general and chief of engineers by President Cleveland. In 1889 he was charged by an act of Congress with the construction of the new Congressional Library building, and in recognition of his integrity and ability, Congress continued him in charge of the work after he was retired in 1895. The death of General Casey removes one of the best known and active government officers. He took great pride in the progress and economy of the work on the new library building, and was to have completed it within the time limit and for less than the original estimates, which speaks well for his ability. He always directed in person the contract work for which he was responsible.

The Strength of Ice.

The army rules are that 2 inch ice will sustain a man or properly spaced infantry; 4 inch ice will carry a man on horseback, or cavalry, or light guns; 6 inch ice, heavy field guns, such as 80 pounders; 8 inch ice, a battery of artillery, with carriages and horses, but not over 1,000 pounds per square foot on sledges; and 10 inch ice sustains an army or an innumerable multitude. On 15 inch ice railroad tracks are often laid and operated for months, and 2 foot thick ice withstood the impact of a loaded passenger car, after a 60 foot fall (or, perhaps, 1,500 foot tons), but broke under that of the locomotive and tender (or, perhaps, 3,000 foot tons). Trautwine gives the crushing strength of firm ice as 167 to 250 pounds per square inch. Col. Ludlow, in his experiments in 1881, on 6 to 12 inch cubes, found 292 to 889 pounds for pure hard ice, and 222 to 820 pounds for inferior grades, and on the Delaware River, 700 pounds for clear ice and 400 pounds or less for the ice near the mouth, where it is more or less disintegrated by the action of salt water, etc. Experiments of Gzowski gave 208 pounds; those of others, 310 to 320 pounds. The tensile strength was found by German experiments to be 142 to 223 pounds per square inch. The shearing strength has been given as 75 to 119 pounds per square inch. The average specific gravity of ice is 0·92. In freezing, water increases in volume from 1-9 to 1-18, or an average of 1-11; when floating, 11-12 is immersed.—Engineering Mechanics.

Earthquake in Maine.

Reports from Machias and Calais, Me., state that a violent shock of earthquake was felt on the evening of March 22 at 8 o'clock. The direction of disturbance was from the south toward the north at Machias and from west to east at Calais. At Machias houses trembled, dishes and windows rattled, and clocks were stopped. People rushed from their houses in alarm. At Calais the shock lasted from four to five seconds. No damage was recorded.

DEEP and rapid breathing is recommended as a means of stopping hiccough.

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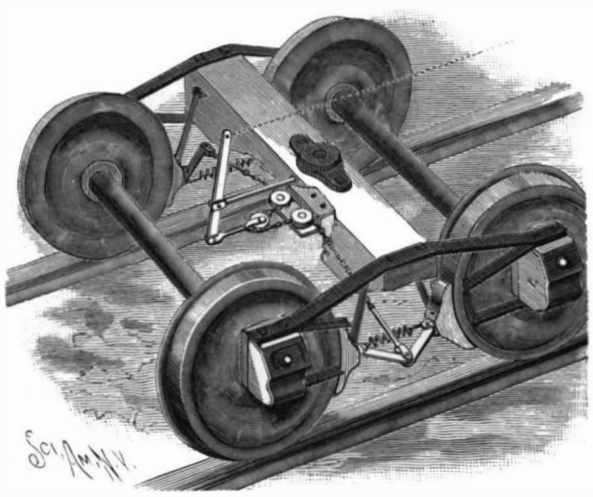
A NEW CAR BRAKE.

The illustration represents an improved car brake, in which the brake shoes are moved into contact with the wheels by the straightening of toggle arms located between the shoes operating against adjacent wheels. The improvement has been patented by Ferdinand Gabler, Topeka, Kansas. The shoes are suspended by hangers and have a loose jointed connection with the toggle arms, and the latter are jointed by a bolt or

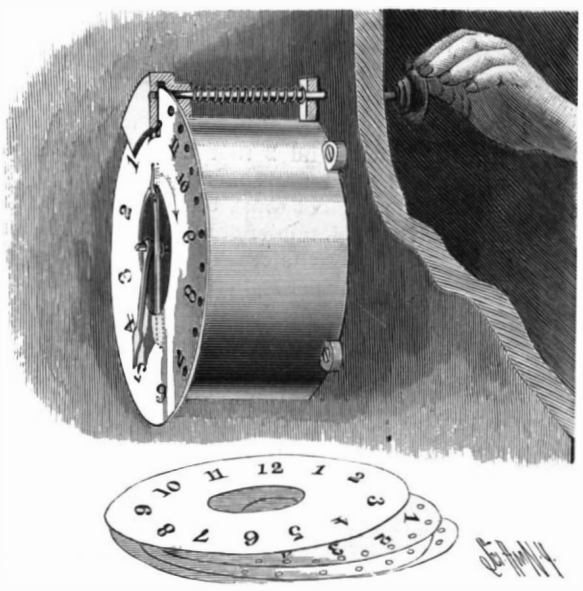


GABLER'S CAR BRAKE.

pintle pin to a stem extending transversely to the middle of the car. The inner ends of the two stems on opposite sides of the car are connected to a chain which passes around two pulleys on a stationary axis and around an intermediate pulley carried by a clevis on the lower end of a brake lever, connected at its other end to the brake chain through which the brakes are applied. Pulling on the brake chain tends to straighten the toggle arms, thrusting the brake shoes against the wheels, from which they are removed, when the tension is released, by a spiral spring connecting the shoes of each pair.

A WATCHMAN'S TIME RECORDER.

A simple and inexpensive watchman's time recorder, especially adapted for use in factories and other buildings, for making a record of the times at which the watchman makes his rounds, is shown in the accompanying illustration, and has been patented by Charles L. Reis, of Richmond Hill, L. I., N. Y. On the hour hand of an ordinary clock secured to the inside of a door or wall is fastened a ring shaped dial, preferably of paper and with markings similar to those of a clock face, this dial being set on shoulders formed in the hour hand. This hand extends across the dial, and a spring holds the paper dial in contact with the hour hand, causing it to travel around with it. On the upper part of the clock casing is secured a guideway through which the upper part of the paper dial passes as it revolves, and in this guideway is arranged to slide a pin adapted to puncture the paper dial when pressed by the watchman, the pin being withdrawn by a coiled



REIS' WATCHMAN'S TIME RECORDER.

spring. The paper dial is simply made, as shown in the small view, and may be readily slipped on the hour hand and held in position thereon by the spring, it being understood that the paper dial is attached to the hour hand to correspond with the indicated time. The punctures made in this dial, when it is removed each morning, indicate the times of the watchman's visits.

FRIENDS of the Lick Observatory will be glad to know that, owing to the open winter, considerable progress has already been made in mounting the 3 foot reflector presented to it by Edward Crossley, Esq., lately M. P. for Halifax, England. In another month it is likely that both dome and telescope will be erected.

Purification of Drinking Water by Means of Filtration.

The importance of pure water in determining the health of a community has long been recognized and cannot be overestimated.

At the present time it is impossible for many cities and large towns to obtain the required amount of water from a naturally pure source, and in the future, with the enormous increase in population and the number of manufacturing towns established along the banks of the small streams and rivers, this difficulty will be manifestly greater. Therefore the possibility of purifying, by artificial means, water which has been polluted by sewage and which contains both organic matter and bacteria, has become a question of great importance in many communities.

In considering any method for accomplishing this object, two things must be borne in mind, viz., its efficiency and its cost. The objections which have been urged against filtration are:

First, that while a filter might remove the coarse material in suspension, it would allow all the organic matter in solution and the bacteria to pass through unchanged.

Second, that even if a filter were efficient for a short time, it soon becomes clogged and saturated, and then the condition of water which passes through is worse than when it entered.

Third, that the cost and maintenance of a properly constructed filter is so great that it cannot be universally adopted as a means of purifying water.

The report of the Massachusetts State Board of Health for the year 1894 contains some very interesting and important facts upon all these points.

For the past seven years the board has maintained an experimental station at Lawrence for the sole and express purpose of testing the efficacy of filtration of water to purify it and render it fit for household purposes. The water tested was that of the Merrimac River, which is lined from source to mouth with manufacturing towns and which may be taken as a fair sample of river water contaminated with a considerable amount of organic matter.

The filters were of all sizes and thicknesses, from those a few feet square and ten inches in depth to the large filter covering two and one-half acres, through which the water supplied to the city of Lawrence has been filtered since 1893.

Chemical and bacteriological examinations were made weekly, and sometimes daily, of the water of ingress and egress. Sand of different sizes was used, and the filters were run both intermittently and continuously. The results of this careful and painstaking investigation, extending over a number of years, and every source of error being eliminated, are both astonishing and gratifying.

From a bacteriological standpoint they prove that a properly constructed and properly managed filter will remove from 98 to 99·84 per cent of the ordinary bacteria in water, and that if such bacteria as the bacillus prodigiosus, which is very similar to the typhoid bacillus, be added to the water in varying proportions, the filter will remove from 99 to 99·993 per cent. The organic matter in solution is greatly diminished and the water is chemically purified.

Moreover, the efficiency of the filter, instead of diminishing, increases with age and use, owing to the formation of a gelatinous coating about each grain of sand, which serves to entangle the bacteria in their progress.

The rate of filtration may reach five million gallons daily per acre of filter without impairing the efficiency. If the surface clogging is properly removed, there will be no appreciable difference in the quality of the filtered water during or after the process of removal.

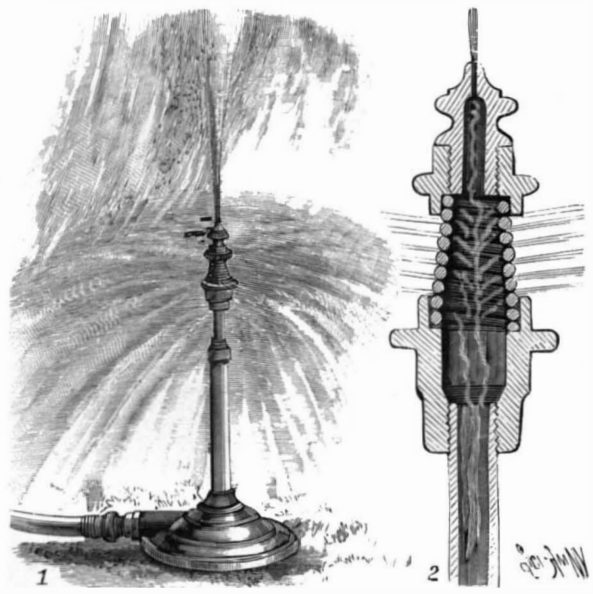
Finally, the cost of construction and maintenance of such filters is not so great as was supposed, and is not to be compared with the benefits derived from their use. The one which has been in successful use in the city of Lawrence proves that the plan is practicable in supplying cities with potable water. It seems to us that the knowledge derived from these experiments should be spread abroad and the attention of municipal authorities called to them.

In the immediate vicinity of New York the water of the Passaic River has been for a long time very bad and is constantly growing worse as regards its contamination with sewage and the waste of manufacturing plants on its banks. Several large cities and towns obtain their water supply from this source, and if there is a practical and economical means of rendering this water pure and wholesome, it certainly ought to be adopted.

While our own Croton is considered a very good quality of water, yet it is liable to contamination, and we have recently had abundant proof that it may become disagreeable to sight and taste. A proper system of filtering would no doubt improve the quality greatly, and the matter should be brought to the attention of the proper authority.—Medical Record.

A NEW LAWN SPRINKLER.

A sprinkler designed to throw a gentle yet effective spray, and which is of simple and inexpensive construction, is shown in the accompanying illustration, and has been patented by Charles A. Ashton, of Piqua, Ohio. Fig. 1 represents the sprinkler in operation, Fig. 2 being a vertical section. A reduced stand pipe supports a spreading head, whose lower section has an enlarged bore and receives the lower end of a closely coiled spring, made fast to the base of the spraying head. To the top of the spring is secured a cap in which screws a plug having a large central bore, with a reduced bore at the top, to make a fine vertical thread of spray when the water is turned on. In operation the water is also forced out horizontally



ASHTON'S LAWN SPRINKLER.

through the interstices of the spring, in a manner quite resembling a miniature fountain. The plug is readily removable from the cap, facilitating the cleansing of the sprinkler from any obstruction.

IMPROVED HORIZONTAL TAPPING MACHINE.

It is in the minor operations in the manufactory or machine shop, no less than in the larger work, that time and money are saved, and profits increased.

Making screws and nuts and tapping parts for receiving screws are among the smaller but important operations carried on in the shop. A great deal of attention has been given to machines for doing this work rapidly and with uniformity.

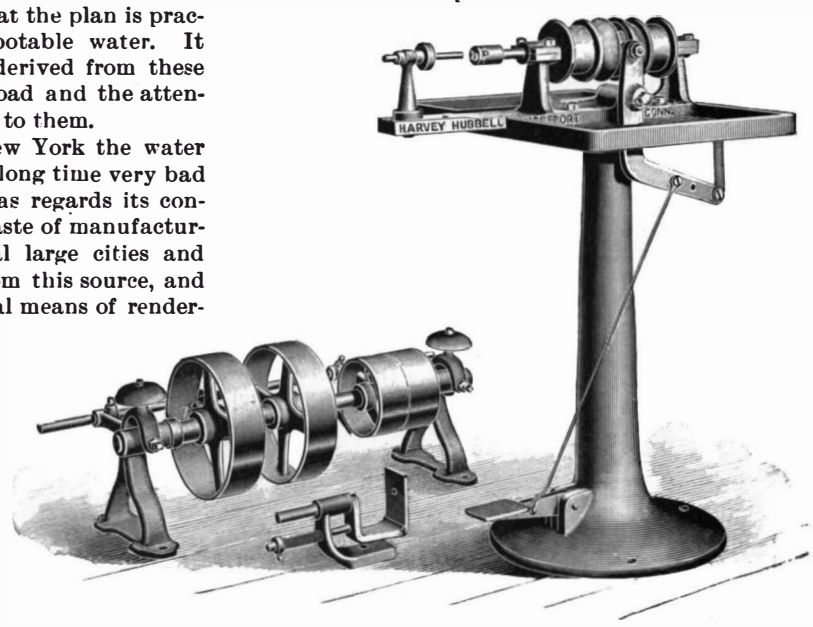
We give an engraving of a machine designed for light, rapid tapping. The spindle is driven by two 1¾ inch belts, running in reverse directions, giving a speed of 1,200 to 1,500 revolutions per minute. The reversing of the tap is accomplished by releasing the foot pressure from the treadle, which, through the medium of a lever, actuates a friction cone.

The machine is fitted with a flat sliding plate for holding work, also a revolving spindle which is especially useful for tapping small pieces. To this spindle may be fitted a work holder, which is wholly under the operator's control, so that, if the tap becomes caught from any cause, it may be instantly released and allowed to revolve, with the work attached, without danger of breaking the tap.

The machine is provided with a substantial countershaft and chuck.

Harvey Hubbell, 875 State Street, Bridgeport, Conn., is the manufacturer of this machine.

IT is reported from France that the fresh juice of the poppy plant applied to recent bee stings gives immediate relief and prevents inflammation.



HORIZONTAL TAPPING MACHINE.

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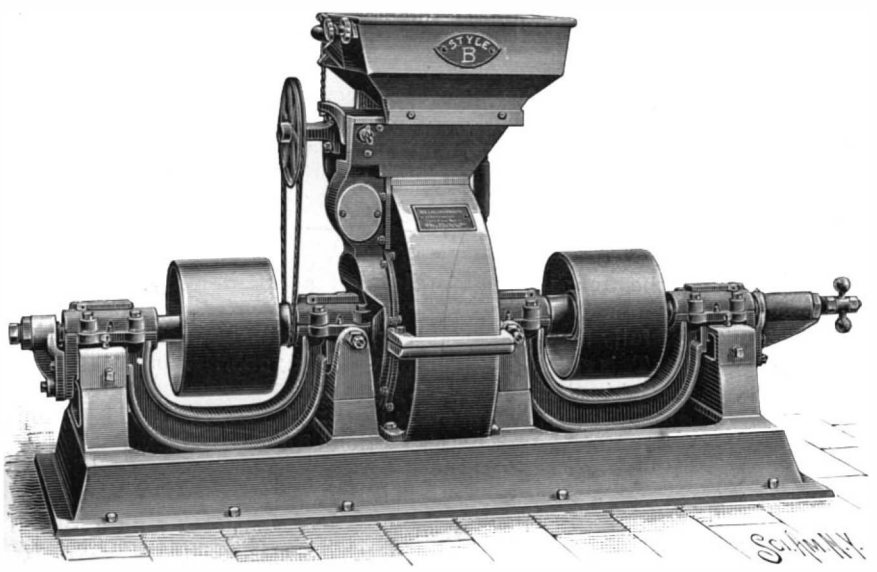
THE ROBINSON CORN AND FEED MILL.

The feeder consists of an iron hopper, shoe and shoe case. The shoe is located underneath the hopper, inside the shoe case, as shown in cut, and is operated by means of an eccentric revolving against a leather cushion, behind which a coil spring is attached, making the shoe noiseless in its operation and maintaining a uniform and positive feed, the eccentric being driven from the shaft of mill by grooved pulley as shown in cut.

To regulate the shake of the shoe and make the motion uniform or steady, a rubber cushion is attached to the side of the shoe case, this rubber cushion being adjustable by means of a thumb screw and nut and any wear on the leather cushion can be taken up.

The back end of the shoe is suspended on an upright spindle which prevents the shoe from rolling and at the same time allows it to be raised and lowered by means of a cord attached to the mouth or the feed opening of the shoe. This cord passes over a knob at the top of the hopper and thence to an adjusting screw and nut, as shown in cut. To further control the feed a slide is placed in the hopper which can be raised or lowered; this slide, together with the adjustable and vibrating shoe, enables the operator to feed heavy or light, as the kind of grain may demand. The feeder, once set for a certain kind of grain, requires no further attention.

This mill is manufactured by Messrs. Munson Brothers, Utica, N. Y.



THE ROBINSON CORN AND FEED MILL.

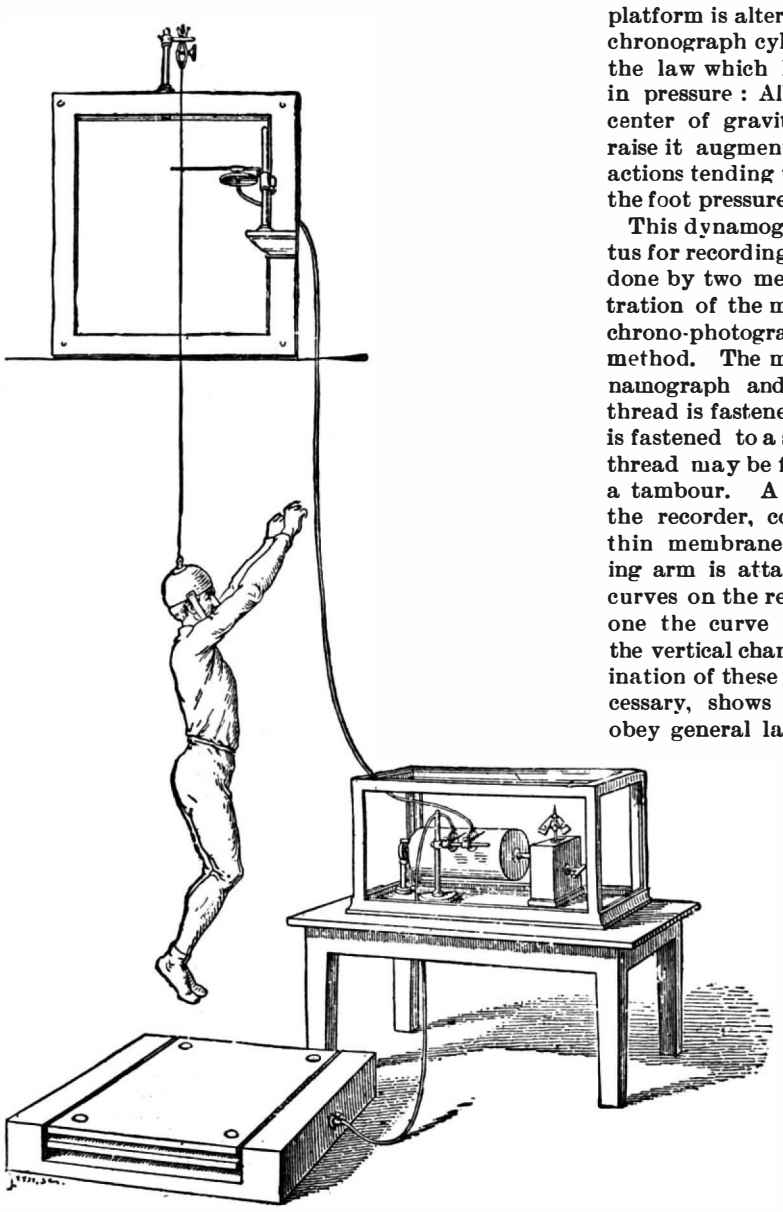
A DYNAMOGRAPH.

The use of instruments of measurement and verification marks the origin of nearly all of the progress in many branches of science and industry. Physiologists particularly have need of accurate instruments when they study the different forms of motion in the functions of life, the velocity of blood in blood vessels, etc. The graphic expression of motion is obtained with facility by using the instruments with which the best physiological laboratories are now equipped. Motion is the most apparent manifestation of life, and besides the internal or organic movements, sometimes so slight that our senses cannot perceive them, there are other external movements the study of which has proved of the greatest value.

Modern physiologists have devised all kinds of instruments and artifices to render these movements visible and to determine their character. To the ordinary inscribing or registering apparatus has been added the photographic methods of Mr. Muybridge and M. Marey. The important researches of M. Marey have already been published in SUPPLEMENTS 336, 408, 414, 579, 580, and 749.

We now present an illustration of another interesting piece of apparatus which is used by him in his experiments. It consists of a dynamographic platform for giving a curve of foot pressure on the ground at the same time in which a mechanical record of the movement is obtained. The dynamograph shown in the engraving consists of coils of India rubber tubing which are more or less compressed according to the external force applied. In consequence of this pressure, the contained air is more or less squeezed out into a chamber connected with the recording instrument. This portion of the apparatus is called a "spiral dynamometer." In the complete apparatus a series of spirals are arranged on an oak platform. All the tubes which lead from the spirals unite in a common collecting tube, which communicates with the chamber of the recording tambour. A plate held in position by clips accurately covers all these spirals. When a man mounts this platform, the registering lever is raised to a variable height and remains in the same position as long as he does not move. If, however, he moves slightly, the amount of vertical foot pressure on the platform is altered in amount and is recorded on the chronograph cylinder. The following is found to be the law which M. Marey finds governs the variations in pressure: All muscular actions which alter the center of gravity of the body in such a manner as to raise it augment the foot pressure on the ground. All actions tending to lower the center of gravity diminish the foot pressure.

This dynamograph may be combined with apparatus for recording the actual movement. This may be done by two methods, either by the mechanical registration of the movement or by the now well known chrono-photography. The engraving shows the former method. The man stands on the platform of the dynamograph and wears a tight-fitting cap; an elastic thread is fastened at one end of the cap, the other end is fastened to a solid support by means of a clip. This thread may be fixed near its upper end to a lever of a tambour. A tambour is the actuative portion of the recorder, consisting of a drum or cup with a thin membrane stretched over it, to which a recording arm is attached. Two tambours produce two curves on the revolving cylinder of the chronograph, one the curve of foot pressure and the other that of the vertical change of position of the head. An examination of these curves, which may be enlarged if necessary, shows that the laws of animal movements obey general laws—in this case, the laws of ballistics.



METHOD OF RECORDING FOOT PRESSURE AND CHANGES OF ELEVATION DURING A JUMP.

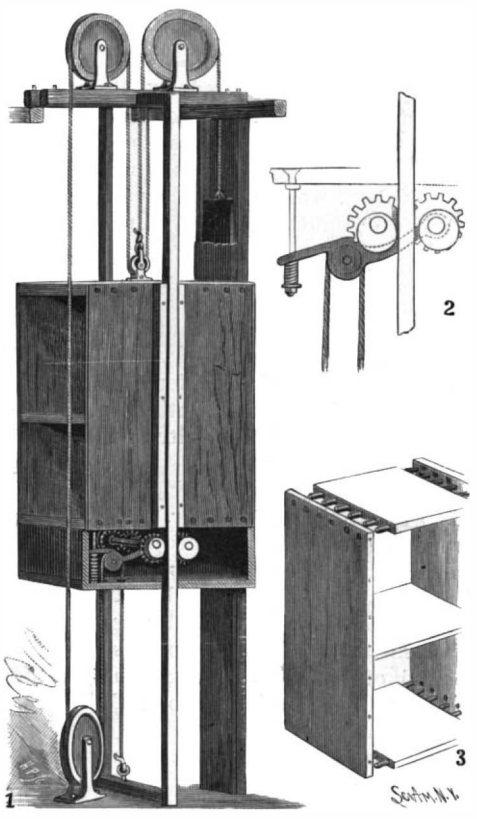
For our engraving we are indebted to M. Marey's late work "Movement," published by D. Appleton & Company, New York City.

Transplanting Large Trees.

The editor of the New York Sun, Charles A. Dana, has a comfortable house with quite extensive grounds in the near neighborhood of New York City, where he has for some years paid particular attention to the care and cultivation of many rare and beautiful plants and trees. On the transplanting of large trees, therefore, as on so many other subjects, he speaks as a high authority, in the following answer to a correspondent: "The transplanting of large trees has been tried very extensively in different countries, and the testimony of all experts is that, while it is sometimes successful, it is yet a very costly and unsatisfactory transaction. In our own experience, out of perhaps thirty large trees of different kinds with which the experiment was tried some twenty years ago, with most abundant care and a liberal disregard of expense, one only is now living, and that not in a very flourishing condition. Take a young tree of a suitable size for transplanting, say five years of age or thereabout, and at the end of twenty years you will have a better result with it than you can have with an old tree, and the young tree will perhaps cost five dollars when planted, where the old one will cost five hundred."

AN IMPROVED DUMB WAITER.

The illustration represents an improvement in the construction of dumb waiters whereby the cage, with its load, will be securely held at any point when the operator releases the rope, the wear on the hoisting rope being reduced and the car relieved of any strain and the cage being also safely held in the shaft without dropping, should the ropes break. The improvement forms the latest of several inventions relating to dumb waiters patented by Mr. Anton Larsen, of 413 and 415 East One Hundred and Twenty-fourth Street, New York City. As may be seen in Fig. 1, the cage is counterbalanced, and the hoisting rope, secured at one end to the upper part of the well, passes under a pulley on the top of the cage, then over a pulley at the top of the well, and extends downward in front of the cage, under a pulley at the bottom of the well, thence upward over a pulley journaled in an arm secured on a transverse shaft in the lower part of the cage. This arm has its free end forked to engage a rod depending from the bottom of the cage, as shown in Fig. 2, a spring on the rod tending to press the arm upward. The shaft carrying the arm is connected by gear wheels with an opposite shaft, and on the outer ends of both shafts are brake shoes in the form of eccentric disks, adapted to engage opposite sides of the guide posts in the well. The cage is moved upward in the well by pulling on the front run of rope, the brake shoes then permitting a free upward movement of the cage, as they are only held in frictional contact with the guide posts by the action of the spring on the arm, but when the pull on the rope is released the spring causes the shoes to bind with sufficient force to hold the cage in position, the pressure of the load also drawing the shoes in more firm contact with the guide posts. The rear run of rope, under the cage, is pulled upon to lower it, causing the arm to swing downward and the turning of the transverse shafts disengaging the shoes from the guide posts, the spring again applying the shoes when the pull ceases. The entire arrangement is completely noiseless, and the operator can conveniently raise and lower the cage and hold it at any desired point. As may be seen in Fig. 3, the frame of the waiter is held together with dowel pins, top and bottom—a mode of construction which renders the car very strong.



LARSEN'S DUMB WAITER.

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Correspondence.

Stability of High Buildings.

To the Editor of the SCIENTIFIC AMERICAN:

I saw in the SCIENTIFIC AMERICAN of March 21 an article on the stability of lofty buildings. Perhaps an instance or two, that came under my personal observation, would be of interest to you. I was in the D. S. Morgan building, corner of Niagara and Pearl Streets, Buffalo, N. Y., during the gale of December 23—I think that was the date. The wind reached a velocity of 73 miles per hour. I was in a room on the eleventh floor, about 120 feet from the ground. A weight was hung to a gas burner by a cord about 2 feet long. The weight vibrated or swung at least 6 inches. If the building did not swing, what caused the weight to move?

On the 4th of March I was at the lighthouse on Hog Island, Va. This is an octagonal structure, of cast and wrought iron. The base is 50 feet. The height to the focal plane, 175 feet. The watch room is about 10 feet in diameter; this and the inclosed stairway is all there is to offer a surface to the wind, except the eight columns and braces. This tower vibrated so that a pendulum clock could not be kept running.

S. T. S.

Ignition Temperature of Acetylene Gas.

To the Editor of the SCIENTIFIC AMERICAN:

In experimenting recently with acetylene, I was surprised to find its ignition point so low that it would take fire through the gauze of a Davy lamp. I tested it by lowering the lighted lamp into a jar of the gas and also by directing a jet of the gas against the lamp. In both cases the acetylene took fire outside the protecting gauze about as easily as hydrogen would. CH_4 and C_2H_4 will not ignite in this way, and it seems strange that the higher carbide C_2H_2 should. It must be very unstable. Can you give any further explanation?

A. E. COLDWELL.

Acadia College, Wolfville, N. S.

[Acetylene gas is known to possess a very low temperature of ignition. It is not very easy to assign a good theory for it. In recent lectures on "Flame and Combustion," by Profs. Lewes, Smithells, and others, as published in our SUPPLEMENTS, you will find given many excellent points in connection with flame, etc. Dr. Lewes' article on acetylene is in our SUPPLEMENT, No. 998. Other papers, by the same authority, on "Flames of Hydrocarbon Gases," will be found in Nos. 876, 1012, 1013. A very good series of lectures, by Prof. Smithells, on "Flames," were given in Nos. 846, 850, 930, 941, and 942.—ED.]

Lumber Destroyed by Fungus.

To the Editor of the SCIENTIFIC AMERICAN:

We to-day express you a package containing two pieces of wood which you will see have been destroyed by some growth, which growth is very common in this section of the country and has found its way into one of our lumber sheds. It is very destructive to all grades of lumber. Please advise us through mail or your columns of a cure for this trouble. Would prefer a wash if one can be had that will do the work.

Beaumont, Texas. M. K. F.

[The matter having been referred to the Division of Vegetable Physiology and Pathology of the United States Department of Agriculture, the chief of division reports as follows:

"The letter and pieces of pine board which you referred to this division from Mr. M. K. F. were duly received. The samples are affected with the ordinary bench rot fungus, mycelium of Polyporus sp. The lumber sheds mentioned should be kept drier if possible. Probably several thorough washings of the lumber and sheds with strong copper sulphate solution, one pound of crystals to the gallon of water, would thoroughly disinfect the lumber. We have washed some of the benches in one of our greenhouses with Bordeaux mixture containing an excess of copper and they are thoroughly free from this fungus, while it is quite common on benches which have not been washed."

B. T. GALLOWAY,
Chief of Division.]

A Novel Cure for Colds.

Among the numerous remedies recommended for colds, the following from the Hospital of February 22, republished in the Literary Digest, is the most novel. It is one Dr. Schnee who propounds the novel cure. Dr. Schnee . . . percusses the terminal branches of the nerves supplying the mucous membrane of the nose with a small hammer made of India rubber. Slight shocks upon terminal nerves have the effect, as has been experimentally demonstrated, of contracting the blood vessels. . . . Stronger shocks produce dilatation of the same blood vessels. . . . Here, then, we have a method of exercising a great deal of control over those nasal blood vessels whose altered condition constitutes the initial stage of coryza. In the inception period of a cold, what is wanted is to set up contraction of nasal and naso-pharyngo-laryngeal blood vessels. For this purpose slight "tappings" with the India rubber hammer are to be resorted to. The locality to which the percussion should be applied is the forehead, just above the root of the nose; and the "taps" should follow a line extending horizontally outward over the eyebrows. The "tapping" should be frequently interrupted and resumed, since it is manifest that continuous "tapping" would overstimulate and finally exhaust the vasomotors, thus exaggerating the very evil the remedy is designed to cure. In cases of chronic catarrh the "tapping" is also valuable, only in this condition it must be of a heavier degree and more sustained; what is wanted being first a free secretion of mucus, and afterward a return to a condition of normal vascularity. The method is interesting, and based on physiological reasoning. Let us hope it will prove as effective in practice as it sounds scientific in description.

Science Notes.

In the Johns Hopkins Hospital at Baltimore, a patient under hypnotic influence was operated upon successfully for diseased kidney, no anæsthetics being used. This case is the first in which hypnotism has been used in that institution.

Laudenbach (Virchow's Archiv, cxli-i, 1895) reports having removed the greater portion of a dog's spleen, and at the end of six months there was a complete regeneration of the entire organ. The removal caused profound disturbance of digestion and impaired nutrition, but notwithstanding this fact the entire organ was reproduced.

According to Prof. Kobert, the active principle of the male fern is not only filicic acid, but also the essential oil, which forms a kind of loose compound with the fatty acid. This mixture, or compound, is easily emulsified in the intestine, and exercises a stupefying action upon the tapeworm, which is then expelled by a laxative. The ethereal extract of male fern should be prepared from the rhizomes gathered in the autumn, says the Phar. Zeitschrift, for the spring collection is less certain in its action.

The Temperature of the Sun.—Prof. Paschen has (says the Gas World) been investigating the temperature of the sun. Among recent observers Rosetti has found a temperature up to 10,000° Cen. by means of a thermopile; Le Chatelier one of 7,600° Cen. by comparing the absorption of solar rays with that of rays from a hot object; Wilson and Gray one of 6,200° Cen. by balancing the radiation from the sun against that from a glowing strip of platinum, in a Boys radiomicrometer; Scheiner one between 4,000° Cen. and 10,000° Cen. by measuring the breadth of the magnesium lines in the spectrum. Now Prof. Paschen reckons it by considering the wave length of the radiation of maximum energy in sunlight as inversely proportionate to the absolute temperature of an incandescent body; and this works out a solar temperature of 5,130° Cen. = 9,266° Fah.

Memory of Bees.—On August 16, says a correspondent in Science Gossip, we took a quantity of honey in frames from the tops of the hives (super honey). The hives are in an orchard at the bottom of the garden. When cleared of bees the frames of comb are usually carried through the garden to a disused cottage at a distance of seventy yards from the nearest hive. On arriving here we found a number of bees, which had preceded us, flying round the cottage awaiting the arrival of the combs, which, however, still remained in the clearers in the orchard. No honey had been taken since June 21 last, and no bees had been noticed near the cottage in the interval.

The American Meteorological Journal will be discontinued with the April number, as it has been carried on at a financial loss ever since its foundation in 1884.

It is quite generally supposed that the sudden and complete freezing of lakes and watercourses must necessarily be fatal to all their inhabitants. Recent experiments by a French scientist, M. P. Regnard, have proved this to be an error. He cooled the water in an aquarium containing live carp to different degrees below freezing. At 0° C. the fishes seemed to fall asleep, but were not frozen. At —3° they were apparently dead, but retained their flexibility. The water being then gradually warmed, they revived, began to swim, and showed no signs of suffering. This would indicate that the polar seas, whose temperature never falls below 3° C., may be a congenial abode for creatures inured to this degree of cold.

The President of the United States has nominated John J. Brice, of California, to be Commissioner of Fish and Fisheries, in the place of the late Marshall McDonald. This office is one of the most desirable of the government's scientific positions and is practically a life office. Capt. Brice is a retired naval officer.

Nearly $800,000 is asked from Parliament for the support of the British Museum for this year.

M. H. Moissan has recently presented to the Paris Academy of Sciences the results of some interesting experiments with carbides. He finds that cerium carbide produced in the electric furnace yields when treated with water seventy-five per cent of acetylene, with much methane and some ethylene. Lithium carbide yields pure acetylene, which is a transparent crystalline mass.

The mortality rate among medical men of France is but twenty-six per one thousand, the actual number of deaths per annum being about 450.

The Swiss botanists, MM. Sommier and Sevier, who have recently explored the Caucasus, says the Popular Science News, tell of a mountain flora of giant herbaceous plants, of which little was known before, which they designate as Macroflora. At the altitude of 5,800 feet, some plants reach a size which they never obtain in the valleys. A campanula, which does not exceed about two feet below, grows to about six feet high at that altitude and has an unpliable stem.

The meldometer, an instrument invented by Dr. Joly, of Dublin, consists of a thin platinum strip which can be heated by the passage of an electric current. Small fragments of a solid substance are placed on the platinum strip, and the temperature at which they melt is deduced from the length of the platinum strip, which has been previously calibrated by means of solids of known melting points. A number of measurements have been made of the melting point of calcium, sodium, strontium, barium and lithium.

Arthur P. Greeley—Value of Civil Service Illustrated.

The value of the civil service requirements as applied to the United States Patent Office is illustrated in the appointment on April 1, 1895, of Arthur P. Greeley, of Concord, New Hampshire, a Republican in politics, by President Cleveland, and since confirmed by the United States Senate on March 6, 1896, to be examiner in chief in the Patent Office. We say the value of the civil service requirements are demonstrated in this case because it was purely merit and ability alone that gained for him the honorable position he has attained; the wisdom of it will become evident in future years.

Mr. Greeley is a graduate of Dartmouth College, in the class of 1883. A lawyer by profession, having been graduated from the law school of the Columbian University of Washington in the class of 1887, taking the post-graduate course at the same school the following year. The next year, 1888, he was admitted to practice in the District of Columbia.

In July, 1884, he entered the Patent Office as a fourth assistant examiner, as a result of his standing in the first examination for appointment to the Patent Office held under the present civil service law. Was promoted through the successive grades of third, second and first assistant and principal examiner solely on merit as the result of standing in competitive examinations held in the office.

As an assistant examiner he served in the division of metal working B and electricity B, in the latter division having charge of the class of electric railways.

On appointment as principal examiner in July, 1891, he was assigned to a newly formed division comprising packing and storing vessels, advertising, etc. Was transferred in 1894 to the division of instruments of precision, and while in charge of this division for a number of months, acted also as examiner of trade marks.

From 1891 to 1893 he was a member of the committee having in charge the preparation, arrangement and installation of the exhibit of the Patent Office at the Chicago World's Fair, which involved an extended consideration of the development of nearly every important art represented in the Patent Office. He was also a member of the committee having charge of the preparation and installation of the Patent Office exhibit at Atlanta.

He is one of the first under the present civil service law to be appointed and advanced through the successive grades and to receive a presidential appointment on merit solely.

Fairs Next Fall.

The following appointments have been made for the State fairs and other important exhibitions of the present year:

American Live Stock, New York	Nov. 23, 28
American Institute, New York	Sept. 28, Oct. 29
British Columbia, New Westminster	Oct. 6, 9
Connecticut, Meriden	Sept. 9, 11
Illinois, Springfield	Sept. 28, Oct. 3
Iowa, Des Moines	Sept. 4, 11
Kansas, Wichita	Sept. 22, 27
Maine, Lewiston	Aug. 31, Sept. 4
Manitoba, Winnipeg	July 20, 25
Massachusetts ("Bay State"), Worcester	Sept. 1, 4
Massachusetts Horticultural, Boston	Sept. 2, 3
Nebraska, Omaha	Aug. 27, Sept. 5
New England, Portland, Me	Aug. 17, 21
New Hampshire Milton	Sept. 7, 10
New Jersey, Waverly	Sept. 7, 11
New York, Syracuse	Aug. 31, Sept. 5
Ohio, Columbus	Aug. 31, Sept. 4
St. Louis, St. Louis	Oct. 5, 10
South Carolina, Columbia	Nov. 9, 13
Toledo, Tri State, Toledo	Sept. 21, 29
Toronto Industrial	Aug. 31, Sept. 12
Virginia Stock, Staunton	Sept. 8, 11
Washington, New Whatcom	Sept. 29, Oct. 2
Wisconsin, Milwaukee	Sept. 21, 26

—Albany Cultivator.

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NIAGARA FALLS HYDRAULIC POWER PLANT.

From many points of view the development of the power plant at Niagara Falls is of special interest. The undertaking from its outset was conceived on original lines, and even in the purposes to which it is applied, such as the production of aluminum, of calcium carbide, and of carborundum, there are elements of novelty and interest. We have already illustrated and described the overground plant, which, with its fine electric machinery, switchboard and accessories, is already regarded as one of the local attractions of Niagara. But the casual visitor fails to see the best of the work. Out of his sight, below the solid floor, and directly beneath the dynamos, a great rectangular pit descends nearly two hundred feet through the solid rock. Near the bottom of this pit the 5,000 horse power turbines are established. Electric elevators traverse the shaft carrying those who have to inspect the wheels and shafting. The aspect of things in the pit is quite impressive, and would be more so were it not that the rapid descent in the elevator prevents the realization of the depth attained.

The development of the water power has involved the solution of many problems in engineering. The astonishingly rapid development of electricity during the last few years has operated to materially change the plans of the engineers. The station now appears as a purveyor of electric energy, while originally it was intended rather to sell hydraulic power. It now sells both, but its electric power plant is the most striking and important development. The power company has installed in its own immense wheel pits near the bottom the great turbine water wheels, from each of which a vertical shaft rises to the ground level to directly drive the rotating fields of the 5,000 H. P. alternators, vertically above and directly in line with the wheels. Both wheels and dynamos are of the horizontal type. For each wheel there is a single dynamo, and each pair coupled together represent a unit of the plant.

In our issue of January 25, 1896, we described and illustrated the power house with its water connections and electric plant. The illustrations showed the relation of the surface canal, which takes water from the Niagara River above the Falls, to the power house, and our issues of March 5, 1892, and of October 20, 1894, may be referred to as giving the general aspect of the tunnel and canal. The present article describes the turbine water wheels, to see which, our readers must descend with us to a point nearly two hundred feet from the surface of the earth, near the inner end of the tunnel.

The turbines were designed by the firm of Faesch & Piccard, of Geneva, Switzerland, and were built by the I. P. Morris Company, of Philadelphia, Pa. It seems a pity that the plans could not have been executed by American engineers, but the point was made that practice in this country has been in the line of supplying turbines from stock on hand, while the Swiss engineers are more in the habit of making special calculations for various cases. The problem to be solved was a difficult one, owing to the high unit of power and to the 140 feet of shafting, whose weight had to be carried. In the accepted design the wheels are double Fourneyron horizontal turbines, one placed vertically over the other, the upper one being inverted. The circle of buckets of each wheel is divided into three horizontal divisions or stories. The water delivered by the penstock enters the space between the wheels, which is inclosed by a casting, constituting a sort of drum. About half of the water rises and, rushing out through the upper wheel, actuates it, while the rest of the water drives the lower wheel. The rising water, pressing upward against the disk of the upper turbine with the stress due to nearly 140 feet of head, supports a variable portion of the weight of the shaft.

Each of the wheels includes two circular portions, one a fixed central guide wheel carrying a peripheral circle of curved buckets through which the water escapes, its direction of escape being determined by the shape of the buckets. In the Niagara wheels these buckets are 36 in number. This guide wheel with its circle of buckets is surrounded by a second circle of buckets arranged on the periphery of a disk, and this disk with its buckets rotates and constitutes the turbine proper. It has 32 buckets curved in the reverse sense referred to those of the stationary one. Each turbine system includes, therefore, the upper and the lower couple, each comprising a guide wheel and turbine, marking the top and bottom of a cast iron drum, into which drum the seven foot penstock of sheet steel enters. The smaller cut shows in section the disposition of parts. On studying this cut it will be seen that the stationary or guide wheels would close the ends of the drum, except that the upper guide wheel is perforated, so that the water passes through it and presses upward against the rotating disk of the upper turbine. Were it not for these apertures, there would be no vertical water pressure upon either upper or lower turbine.

The small cut shows bars running diagonally up and down within the drum. These support the lower guide wheel, which is subjected to the hydraulic head produced by the penstock. The relation of guide wheel buckets to turbine buckets is shown in the small partial horizontal section in the same cut.

The vertical shaft which transmits the revolutions of the wheel to the dynamo is of sheet steel riveted up to form a tube 38 inches in diameter, except at two intermediate bearings and at the upper terminal bearing. At these points reduced sections of shafting 11 inches in diameter are used.

To regulate the speed of the wheel a governor is provided, which operates by raising and lowering a double annular speed gate. This works up and down outside of the peripheries of the upper and lower turbines, cutting off the outlet for water as it rises, and giving a larger opening as it descends. In the sectional view the speed gates are shown closing about two-thirds of the orifice, and on the deck above is seen the bearing for the speed gate lever, which is shown extending horizontally across the cut just above the floor level. The governor is guaranteed to keep the speed within two per cent of the rate desired under ordinary conditions.

Should the work be suddenly increased or diminished to an extent of twenty five per cent, the governor will hold the speed variation down to four per cent.

A vertical thrust bearing, similar, except that it is vertical, to that on the shaft of a screw propelled ship, is provided near the upper end of the shaft. This is necessary, because the varying inflow of water causes the pressure exerted by the shaft to vary. This pressure may even sometimes be negative or upward.

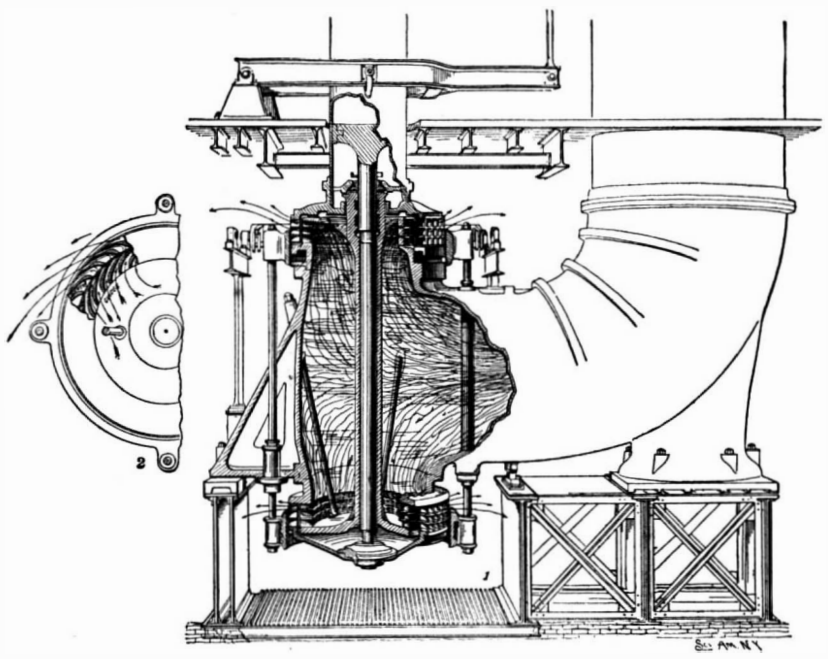
The wheels discharge at full load 430 cubic feet of water per second and utilize 136 feet of head, the wheels rotating 250 times per minute. At seventy-five per cent efficiency they give 5,000 horse power.

The original idea was to have a ten ton flywheel 14½ feet in diameter on the shaft. The rotating field of the dynamo takes the place of this.

Our large cut shows the great wheel at work. The water is seen escaping from the curved buckets. Bars of iron are seen running up and down the outside of the barrel, which bars operate the annular speed gates, the lower one of which appears below the outflowing water. The speed gate lever and sheet steel tubular driving shaft are seen above the wheel, and the penstock rises on the left hand. The outflow passes through a curved sluiceway into the tunnel. By rock shafts and levers the bars for working the speed gates are increased in number. From the governor, directly over the top of the shaft, a single bar connects with the speed gate lever. From this lever two bars descend to the gates and connect also with the rock shaft, throwing other bars into action. The governor works centrifugally.

The total horse power of Niagara Falls in a recent paper was put at 6,750,000, due to a descent of 275,000 cubic feet of water per second. This is taken as representing a coal consumption of 65,000 tons per day. The tunnel is the factor which determines the fraction of the power which can be utilized, and, as calculated, it can deliver sufficient water to generate 120,000 horse power. This exceeds the developed horse power in eleven of the principal water power sites in the United States. The power company have further rights affecting operations on both shores, which will make possible the development of a total of 450,000 horse power. This represents over one-third of the power of all the water wheels in the United States by the census of 1880.

The power plant in most of its parts was installed by the Cataract Construction Company for the Niagara Falls Power Company.



SECTIONAL VIEWS OF ONE OF THE NIAGARA TURBINES.

A Geological Expedition to Patagonia.

Princeton College has planned another important geological expedition. Prof. J. B. Hatcher, Curator of the Museum of Vertebrate Palaeontology, accompanied by Mr. T. A. Paterson, formerly connected with the American Museum of Natural History in New York, has sailed for Patagonia. The explorations on the coast of Patagonia which were conducted by Prof. Darwin in his famous voyage in the Beagle, nearly half a century ago, first directed the attention of geologists to the great scientific importance of that inhospitable land. In later years the work which he inaugurated has been prosecuted by the Argentine palaeontologists Burmeister, Moreno and the brothers Arneghino.

The latter brought together a large collection of fossil mammals and birds and made important studies upon them, although they labored under great difficulties on account of the absence of material from the northern hemisphere for comparison. Two years ago St. Morens, the director of the Museum of La Plata, invited Mr. Lydekker from England to study the collections of that museum and to employ his extensive knowledge of the collections of Europe and Asia with the purpose of comparison with the fauna of South America. Mr. Lydekker has published two large volumes as the result of his studies, which, though interesting and important, show that a vast amount of work remains to be done on the geology of Patagonia.

Princeton has now taken advantage of this opening and has sent out a well-equipped expedition. After studying the collection in Buenos Ayres, Mr. Hatcher will sail for Patagonia and then strike inland; the principal objects of the expedition are to make a thorough study of the Patagonian geology, which has not as yet been undertaken by a competent observer, and secondly to make as exhaustive a collection as possible of the fossils which are so abundant there, and which will be brought to Princeton for study and comparison with those of the North. Though the principal objects of the expedition are thus seen to be geological and palaeontological, the other natural sciences have not been neglected. Preparations have been made to form extensive collections in the mineralogy, zoology and botany of Patagonia and Terra del Fuego to enrich the Princeton Museum. A complete photographic apparatus has been taken along so as to get a large collection of views illustrating the geology of the country and the customs of the natives. Mr. Hatcher also holds two commissions from the United States government, one from the Department of Agriculture and one from the Bureau of Ethnology, and the officers of the government have done everything in their power to render the expedition successful. Mr. Hatcher goes with practically an unlimited leave of absence, and the results of his researches promise to be very interesting.

The Work of Bees.

A writer in the Revue des Sciences Naturelles makes the following calculations in regard to the work done by the honey bee: When the weather is fine, a worker can visit from 40 to 80 flowers in six or ten trips and collect a grain of nectar. If it visits 200 or 400 flowers, it will gather 5 grains. Under favorable circumstances, it will take a fortnight to obtain 15 grains. It would, therefore, take it several years to manufacture a pound of honey, which will fill about 3,000 cells.

A hive contains from 20,000 to 50,000 bees, half of which prepare the honey, the other half attending to the wants of the hive and the family. On a fine day, 16,000 or 20,000 individuals will, in six or ten trips, be able to explore from 300,000 to 1,000,000 flowers, say several hundred thousand plants. Again, the locality must be favorable for the preparation of the honey, and the plants that produce the most nectar must flourish near the hive. A hive inhabited by 30,000 bees may, therefore, under favorable conditions, receive about two pounds of honey a day.

THERE are to be about 200 railway stations distributed over the new Siberian railway. The rolling stock will comprise 2,000 locomotives, 3,000 passenger cars, and 36,000 goods wagons. The passenger traffic will be almost exclusively confined to third and fourth classes, and the tariff will be very low. The works in connection with this great undertaking are being pushed on with much energy, and the work is expected to be completed in from five to six years. The opening of this line will shorten the journey round the world by about 20 days. The speed on most of the line, however, will not generally exceed about 15 miles an hour.

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PRESS FOR MAKING STEEL BICYCLE RIMS.

One of the most recent examples of the ingenuity of the modern bicycle maker is the production of a jointless felly, or rim, for wheels. The importance of the cycle industry at the present day is well illustrated by the fact that quite a large factory has been established for the production of these jointless rims.

The advantages of the jointless rim are a nearer approach to uniformity in size; a more equal tension of the metal; and, by avoiding the heat of brazing, the metal is not softened.

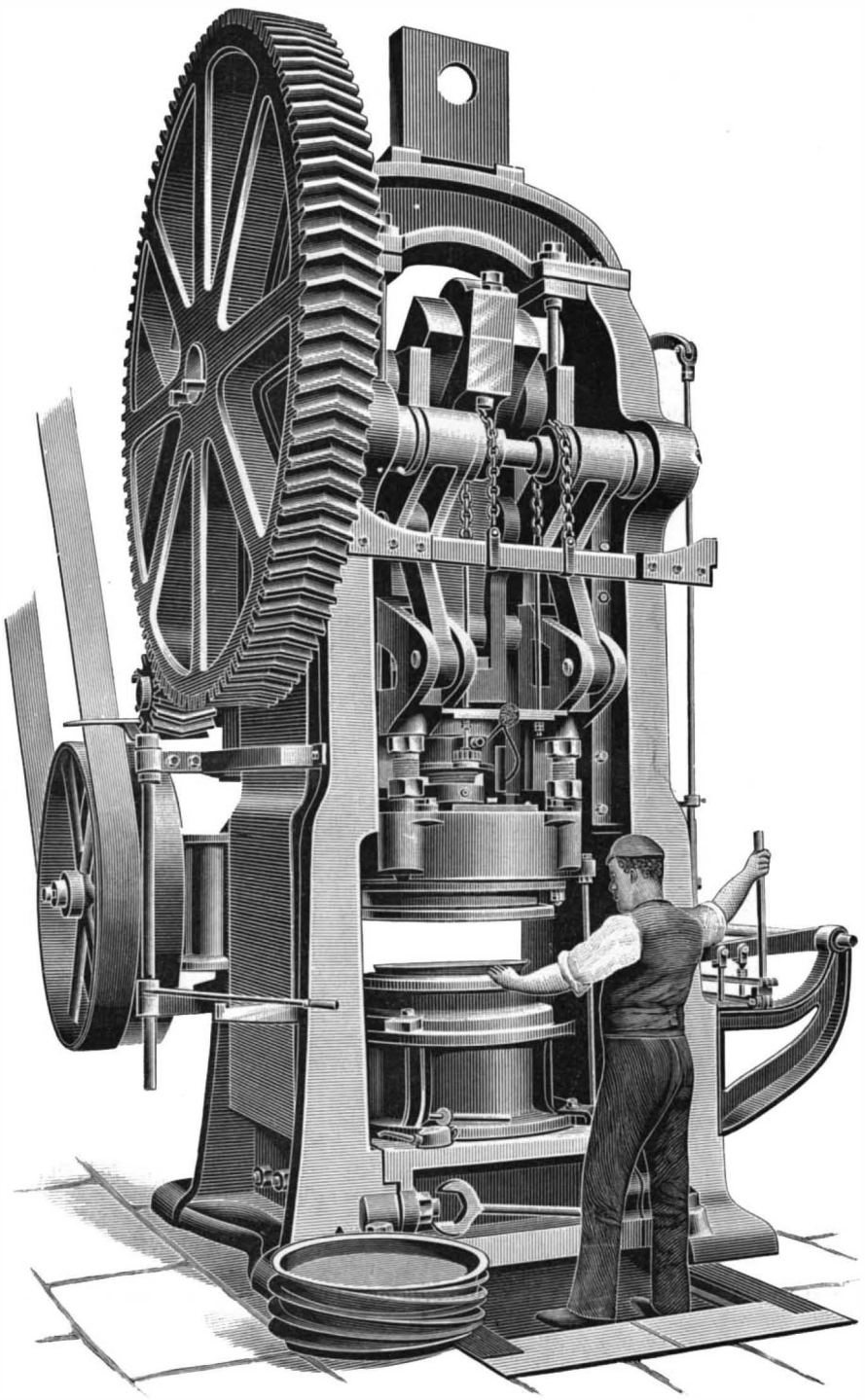
The steel sheets from which the rims are made come in from the rolling mills in the form of squares. The steel is of a kind made specially for the work, the composition having been decided by Mr. C. H. Pugh, the designer of the machinery about to be described, after a long series of chemical and physical tests. It is, of course, the product of the Siemens furnace, and must necessarily be of a very excellent quality, otherwise it would not stand the treatment to which it is subjected. To judge by its working, we should suppose it to be a steel made from hematite ore in a basic lined furnace. but on this point we have no information.

The square sheets are taken through a circle cutting machine and the corners sheared off. There is formed in this way a blank, consisting of a flat circular sheet of metal, and this is taken to a big power press, which we illustrate. These presses have been designed specially for the work, and supplied by Messrs. Taylor & Challen, of Birmingham. They are placed three in a row. They are powerful machines, each weighing about 35 tons, and are capable of admitting a blank 44 inches in diameter, which they will draw down to a pan-shaped piece 22 inches in diameter and 11 inches deep, if required.

In these presses the circular sheets are pressed into the form of a shallow dish with a turned-over rim. In the view of the press a number of the blanks that have just been stamped are shown. In working the press the blank is placed on a flat ring of metal or die. The outer slide then comes down and holds the blank round its circumference. In this way a ring of metal is between the annular tools, it being held tightly enough to prevent the steel from buckling when dished, and yet not so tightly as to prevent it flowing between the tools when the stamp comes down. It will be easily understood, under these circumstances, that the press has to be very carefully made. The steel blank being held in this way, the inner slide descends, and the circular sheet is pressed into the dished form. It will be seen that, so far, the practice followed in the preparation of hollow ware is here adapted to the manufacture of bicycle wheels.

The next process is to cut out the center of the blank, by which operation it is converted from its dish or plate like form to that of a circle, and begins to have some sort of resemblance to a wheel rim. The cutting out of the center is done in a lathe having a pair of revolving shears mounted on a slide rest. The inside cutter is brought up until it just touches the work, and the cutter on the other side is then pressed home by a lever. The partly formed rim is then brought to the requisite section by a number of spinning processes.

Hollow fellies are composed of two separate rings, which are ultimately soldered together. These are known as the block and tread, each of which is prepared in the same general manner, for each has to be brought to a shallow U-section, though the block or inner ring is a deeper U than the tread, or outer ring, against which the India rubber tire abuts. The block, it will be understood, is that part which



PRESS FOR MAKING STEEL BICYCLE RIMS.

is drilled to take the spokes. We are now describing roughly an ordinary form of rim for pneumatic tire. There are many special forms required for varying descriptions of tires, but the same principle of construction governs all. When the central part of the dish-shaped blank was cut out, as described, a ring somewhat of Z-section was left, or more correctly speaking, of the section of an angle bar and reverse angle, the corner of one angle having been previously rounded off. By means of the various spinning lathes, one angle is gradually turned over, and, during successive operations, the corners are rounded off to form the U. The chief point of interest about these lathes is the method of chucking. In one series of operations a large split chuck is used, the work being held by its inner flange between two disks. The spinning tool is brought up by a slide rest, and is recessed to the shape required for the work, the latter being pressed between the tool and the edge of the chuck, which is also of the required contour, naturally the same as the tool, but in relief in place of being recessed. In another operation, the rim, having been brought approximately to shape, is placed between two disks, the rims of which are beveled and hollowed so that when they come together they form a moulding surface upon which the rim can be pressed to shape by the spinning tool.

After the two parts of the rim have been spun to the required section, the edges are trimmed off in a lathe, a pair of circular revolving shears being used as a cutter. The next operation is to put the treads in a press and flatten them so that their edges lie in one plane exactly, the true running of the wheel when finished naturally depending upon accuracy in this respect.

The parts are next tinned, having previously been treated in weak acid to remove grease. The tinning is performed by turning the rim vertically while its lower part dips into a bath of melted tin, the excess of metal being rubbed off by boys with rags or cotton waste.

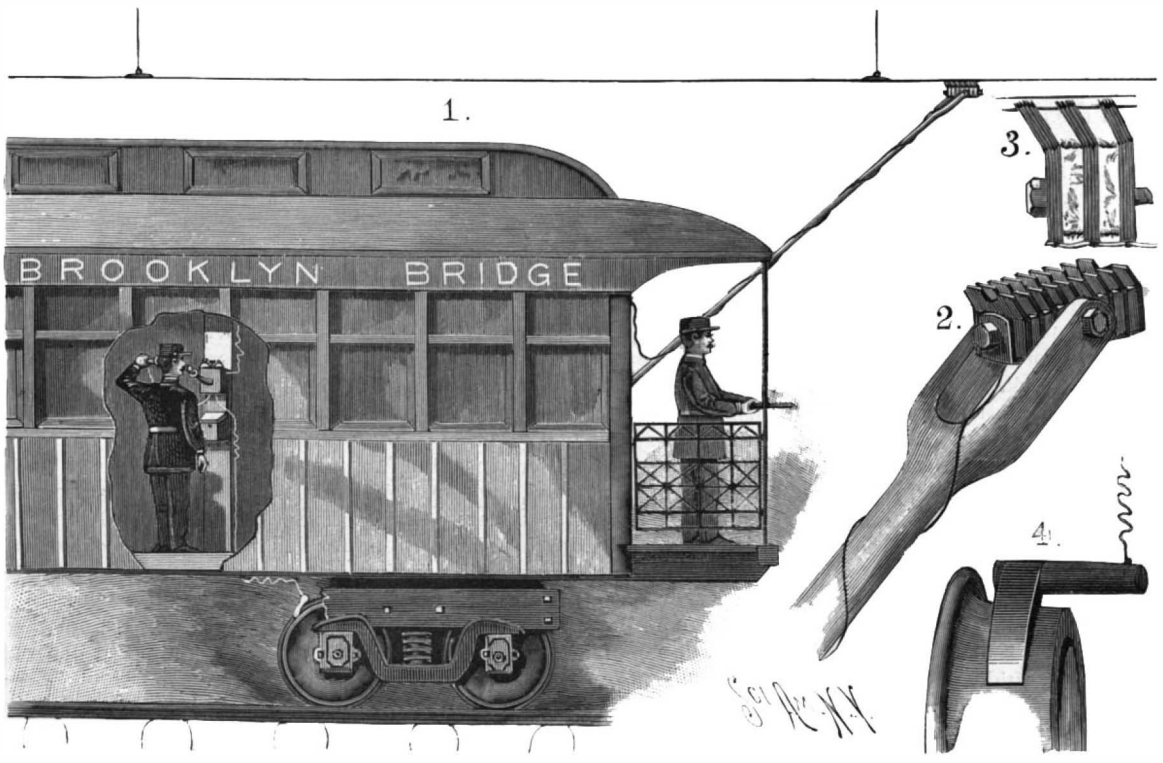
After a careful examination has been made of the tinned parts, the tread and block are put together so as to form the hollow rim. It is at this part of the operation that the necessity for accuracy in the work is most apparent. Unless the two parts are of the required diameter within extremely narrow limits of error, the wheel will be ill-formed and weak in structure, or not of the required dimensions.

When the tread has been fitted into the block, the edges of the latter overlap those of the former, and these overlapping edges are worked up by spinning in a lathe and gradually turned over the edges of the tread. The felly or rim as now formed consists of two hoops of steel placed one within the other. They are both U-shaped or hollow in section, the convexity of each being in the same direction. The tread is formed to a curve of larger radius than the block, and as the edges of each ring are brought together they necessarily meet in a cusp, or, in other words, the space between the two rings, which gives the hollow felly, is crescent-shaped in section.

It now only remains to solder the two parts together in order to make the turned-over joint firm. This is done in the same manner as the tinning operation, before described.

The test for breaking is equal to the strain that would arise if the rim were placed horizontally, supported only at two opposite points of its circumference, and a 14-stone man were to stand on it, each foot being midway between the points of support. After being subjected to such a test, the rim is tried in a lathe to see if it has received any permanent set.

We are indebted to Engineering for our illustration and the above particulars.



TELEPHONING FROM MOVING CARS.

TRAIN TELEPHONY.

Some interesting experiments have recently been tried by Mr. Kingsley L. Martin, assistant engineer on the New York and Brooklyn Bridge, in the line of establishing telephonic communication between moving trains and between trains and the train dispatcher's and bridge offices.

The necessity of some adequate method of train communication and signaling in cases of fog or some emergency has been felt, but there have been difficulties in the way of establishing telephonic communication with moving trains that have prevented it from being put into practice.

Mr. Martin has overcome these difficulties and has succeeded in communicat-

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ing with moving trains with the same facility as between fixed points. The bridge is provided with a trolley wire for electrically lighting the trains. This wire, which was used in the telephone experiment, was connected with the train dispatcher's office and with the bridge offices, and upon the cars were placed arms provided with compound brushes which touched the trolley wire. The circuit was completed through the car truck and track rail, the connection between the circuit wires and truck being completed by a brush resting on one of the car wheels.

The compound brush consisted of a number of brushes of brush copper fastened together with intermediate pieces of soft rubber. The brushes being electrically connected with each other and with the telephone wire, arranged in this way, unbroken conversations could be carried on while the trains moved along. The electrical contact of the compound brush with the trolley wire was so perfect that the sliding of the brush on the wire produced no noticeable effect.

It is proposed to permanently equip the cars with telephones and to provide a suitable electric conductor on the bridge in convenient position for contact with the brushes carried by the cars.

THE THERMOPHONE.

The thermophone is an instrument for measuring temperature, particularly the temperature of a distant or inaccessible place. It was devised by Henry E. Warren and George C. Whipple, in 1894, for the purpose of obtaining the temperature of the water at the bottom of a pond. The first experiments were so successful, says the Progressive Age, that they were encouraged to study further into the capabilities of the instrument, with a view to adapting it to various scientific and commercial uses. These studies led them to believe that the thermophone is an instrument of great value, not only for obtaining deep sea temperatures, but for many meteorological and scientific purposes.

The apparatus which is here presented for inspection resembles Siemens' resistance thermometer more than any other. It takes advantage of the fact that different metals have different electrical temperature coefficients. The accompanying diagram illustrates the general arrangement.

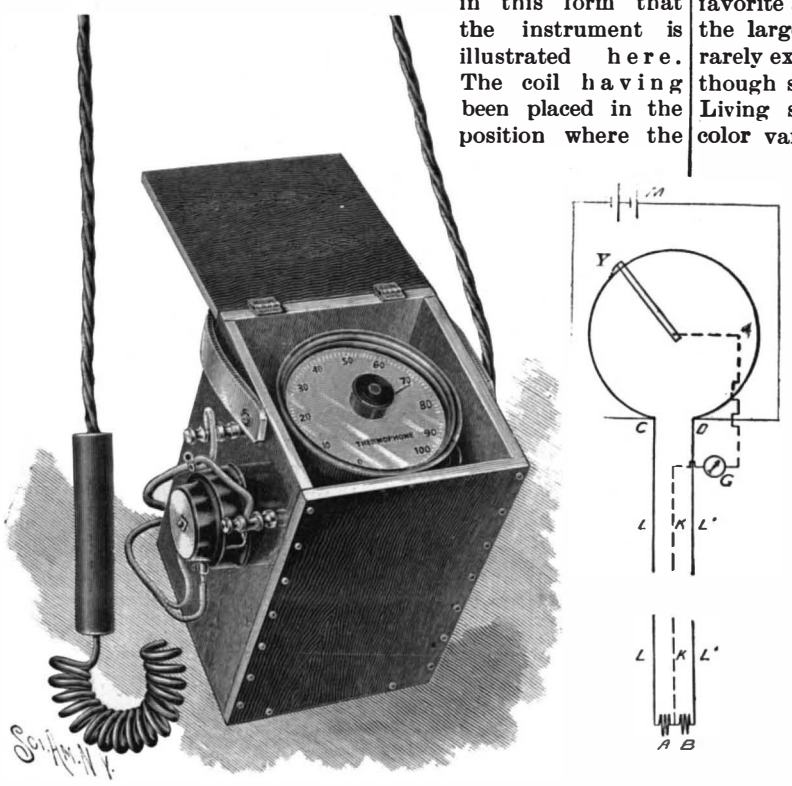
A and B are coils of different metals placed in proximity and joined together as shown in the figure. These coils are connected with a slide wire, CD, by means of the leading wires, L and L'. The two ends of CD are connected in circuit with a battery, M. A galvanometer, G, is put into a leading wire connecting the junction of A and B with a movable contact, Y, on the slide wire. The galvanometer will indicate zero current when $\frac{A}{B} = \frac{CY}{DY}$ But A and B, having different temperature coefficients, will vary in resistance at different rates with changes in temperature; consequently there will be a different value of $\frac{A}{B}$ for every temperature. The value of $\frac{A}{B} = \frac{CY}{DY}$ may be directly read from a scale placed under the sliding contact, Y, or the temperature corresponding to the given ratios of $\frac{A}{B}$ may be marked upon the scale.

The slide wire is wound around the edge of a disk above which there is a dial graduated in degrees of temperature. The hand on the dial is directly over the movable contact on the slide wire, and both are moved by turning a knob in the center of the dial.

It is easily seen that the temperature of the slide wire, CD, has absolutely no effect upon the reading of the instrument, for being made of one piece of metal, which has the same temperature throughout its length, each portion of it will rise or fall in resistance at the same rate with changes in temperature; consequently the ratio of its parts will not vary. The effect of temperature changes on the leading wires, L and L', will not sensibly affect the reading for the same reason.

In place of the galvanometer it has often been found advisable to use a telephone, in connection with a circuit breaker, to show the presence of a current. It is in this form that the instrument is illustrated here. The coil having been placed in the position where the temperature is desired, the transmitter is taken from its hook on the left hand side of the box and held to the ear while the right hand of the operator turns the knob over the dial until a point is reached where no sound is heard. The dial hand then indicates the true temperature. If desired, a number of coils can be located permanently at a number of distant points and thrown into connection with central dial box, at will, by means of a little switch board; a scheme which might be valuable for practical application in a large gas works, as it would enable the superintendent to ascertain the temperature at any given set of points in the works at any time without his leaving his office or desk. This instrument, as we are informed, is more sensitive than a mercurial thermometer. It can be made with any desired range, and its readings are independent of pressure, an important feature in a deep sea instrument.

E. S. Ritchie & Sons, Brookline, Mass., are manufacturers for the United States and Canada.



THE THERMOPHONE.

THE FRILLED LIZARD—CHLAMYDOSAURUS KINGI.

The above named lizard inhabits the northern or tropical territories of the Australian continent, and is tolerably abundant in both North Queensland and the Kimberley district of Western Australia.

The habitat of the frilled lizard is essentially sylvan, its resort being the thickly wooded scrublands, and its favorite abiding place the trunks and lower limbs of the larger trees. The length of the finest examples rarely exceeds three feet, and of this the long, rough, though slender tail monopolizes the greater moiety. Living specimens exhibit a considerable individual color variation. The predominant hue of the body is pale brown with reticulated markings, while the frill, in the males more especially, is usually decorated with interblending tints of yellow, scarlet and steel blue.

No living example of this singular lizard had, up to the present year, been brought alive to Europe, a circumstance which will account, to a large measure, for the fact of certain abnormal phenomena connected with its life habits having hitherto attracted little or no scientific attention. Through the possession of living specimens of Chlamydosaurus in both Queensland and Western Australia, several interesting data concerning the species have fallen within my notice.

Having, furthermore, succeeded in bringing one out of several examples embarked safely to England, my presentation of the animal to the Zoological Society's Gardens, where it was on view for some weeks, has afforded many fellow naturalists the opportunity of verifying the phenomena here recorded. The most conspicuous structural feature of Chlamydosaurus kingi is the extraordinary development of the cuticle of the neck, that gives to it its popular title. This takes the form of a voluminous frill or collar, which, while the animal is at rest or undisturbed, is neatly folded in symmetrical pleats around the creature's neck and shoulders. No sooner, however, is the lizard excited to hostility by the approach of a threatening assailant, than, coincident with the opening of the mouth, the frill is suddenly erected, much after the manner of the unfurling of an umbrella, and stands out at right angles to the longer axis of the body, measuring under such conditions some seven or eight inches in diameter.

The mechanism by which the erection and depression of the frill of Chlamydosaurus is accomplished is intimately connected with a slender process of the hyoid bone, which traverses the substance of the frill on each side, and is so adjusted that the opening of the creature's mouth and the erection of the frill are synchronous operations. A characteristic photograph from life of this lizard in a condition of excitement, and standing at bay, with mouth open and frill erect, is afforded by Fig. 1, representing one of many I was fortunate in securing from the specimen I brought to England.

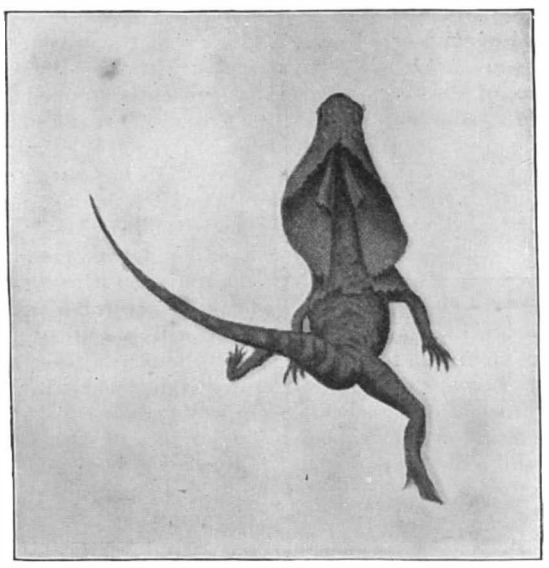


Fig. 2.—CHLAMYDOSAURUS RUNNING ERECT.
Posterior View, taken with Anschutz hand camera.

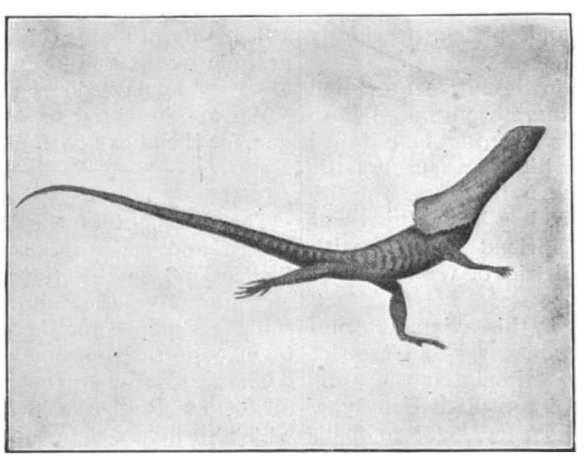


Fig. 3.—CHLAMYDOSAURUS RUNNING ERECT.
Profile View.

The function of the frill in Chlamydosaurus is, as apparently indicated by the circumstances and conditions under which alone it is displayed to view, purely that of a "scare organ," wherewith by its sudden expansion many of its would-be assailants are frightened and deterred from attacking it. Instances have, in fact, been recorded to me of dogs, which will readily rush upon and kill other and larger lizards, such as Varani, refusing to come to close quarters with so formidable looking an object as Chlamydosaurus, when it turns upon them with gaping mouth and suddenly erected frill.

Chlamydosaurus displays, however, additional defensive tactics. When approached these lizards will often spring aggressively at the intruder, and in addition to using their not very formidable teeth, will lash sideways with their long, rough tails with such vigor as to smartly sting the hand which may fall within range of the unexpected impact.

The natural food of the frilled lizard consists almost exclusively of Coleoptera and other bark-frequenting insects, a fact which emphasizes the difficulty of keeping them long in a state of captivity. The several specimens in my possession became fairly accus-

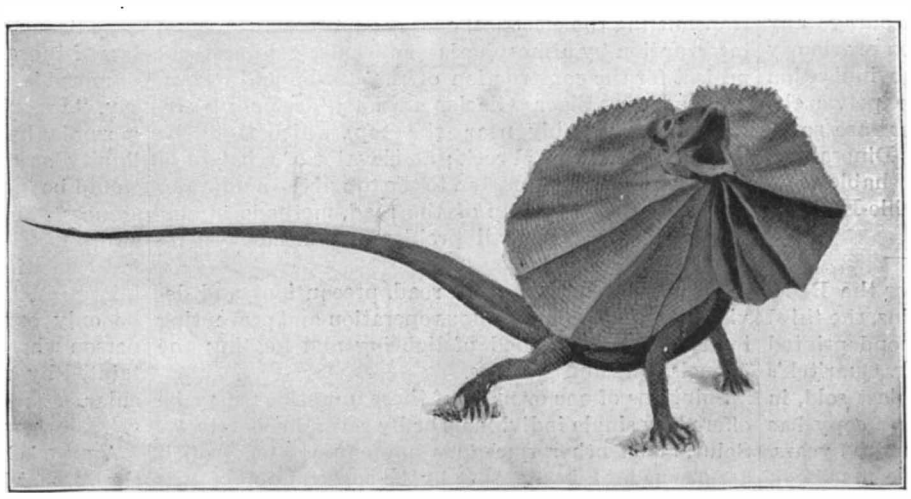


Fig. 1.—CHLAMYDOSAURUS KINGI STANDING AT BAY WITH ERECTED FRILL.

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tomed to dieting on raw meat, though they would not take to this artificially substituted pabulum voluntarily. On the slightest excitement, however, they would open their mouths and erect their frills, and on which occasions it was a simple matter to administer pieces of meat, which were then readily assimilated.

The most remarkable feature placed en evidence by the specimens I kept in captivity was their peculiar method of perambulation. The statement that the frilled lizard was in the habit of running erect on its hind legs only was made to me in Queensland some years ago. I failed, however, to verify this assertion through the single living specimen I there had in captivity for a short interval; and neither was a friend in the northern district of the colony more fortunate, who, at my request, made experiments with several specimens. I was, on these grounds, inclined to suspect that the rumor that had previously reached me was the outcome of an optical illusion, many lizards, such as Grammitophoræ, running so erect on their haunches that it might be imagined their fore limbs were raised from the ground.

It was, consequently, to my no small gratification and delight, on becoming the owner of several specimens, including the one brought to England, obtained for me, with the assistance of the aborigines of Roebuck Bay, Western Australia, that I found myself in a position to fully establish the truth of the report concerning the erect gait of Chlamydosaurus that had been communicated to me in Queensland. Possibly the specimens previously experimented with had been slightly injured during capture and lacked the stamina to walk upright. At all events the Roebuck Bay examples, brought in straight from the bush, were in vigorous health, and at the first trial when left at liberty, save for a light retaining cord, ran along the ground almost perfectly erect, with both their forelimbs and long tails elevated clear of the ground.

The attempt was made on the spot to permanently register, with the aid of the Kodak camera, the absurdly grotesque appearances these lizards presented when progressing in this bipedal fashion. Such, however, was the speed at which the animals ran, that the shutter of that instrument did not work fast enough to secure anything better than a blur at close quarters, and it was only by bringing an Anschutz camera with its most rapid roller blind shutter to bear on this specimen, after its arrival in London, that the Figs. 2 and 3, here reproduced, were secured. While even these partake much of the nature of silhouettes, they will serve to indicate the more characteristic running attitudes which this lizard may assume.

Fig. 2 in this series carries with it so essentially human an aspect that one is sorely tempted, at the risk even of incurring scientific contumely, to place a cricket bat in its right hand. The distance Chlamydosaurus will traverse in this remarkable erect position may average as much as thirty or forty feet at a stretch, and then, after resting momentarily on its haunches, it will resume its running course. When, however, a short space of a few yards only has to be covered, the animal runs on all fours, sitting somewhat high on its haunches after the manner of many ordinary lizards, such as the Grammitophoræ, previously referred to.

The profile outline of Chlamydosaurus, presented by Fig. 3, is peculiarly interesting, since it possesses so much in common with that of a running long tailed bird, such as a pheasant. This bird like aspect of the frilled lizard, as exhibited when it crosses the observer's path in bipedal fashion, has been the recent subject of remark to me by a friend familiar with the species in the Kimberley district of Western Australia.

Special interest is attachable to this avian like ambulatory deportment of Chlamydosaurus by reason of the generally accepted interpretation that the birds are modified descendants of a reptilian archetype. The temptation is naturally also very great to institute comparisons between, and to suggest possible affinities with, this peculiar lizard and the extinct group of the Dinosauria, and among whose representatives a bipedal locomotive formula was apparently a characteristic feature. A reference, however, to the skeleton of Chlamydosaurus does not encourage any sanguine anticipations that may have been previously entertained in this direction. It yields no indication of that peculiar avian modification of the pelvic elements, adapted for bipedal locomotion, that are so essentially diagnostic of the more typical Dinosauria, while in all general points it is indistinguishable from that of the ordinary Agamidæ.—W. Saville-Kent, in Nature.

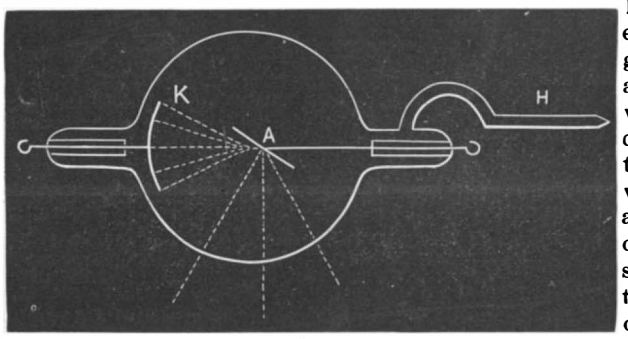
A PSALTER printed on vellum in 1459, for the Benedictine monastery of Sankt Jakob, at Mainz, the third book from the Mainz press and the second printed book with a date, is offered for sale in Mr. Quaritch's Liturgical catalogue for $26,250. When last sold, in 1884, this copy brought $24,750. No other copy has appeared in the market for almost a hundred years. It is far rarer than the Mazarine Bible, the first book ever printed.

THE NEW X RAY "FOCUS" TUBE.

A new tube for producing the X rays has recently been designed by one of the professors at King's College, London, which is so great an improvement on anything in this line that has been previously produced that it will undoubtedly give a great impulse to the practical applications, especially to surgery, of the new photography.

The sharpness of the image obtained in these photographs is due to the fact that the cathode rays are focused to a point where they impinge on a plate of platinum fixed on the anode. The X rays which produce the photograph radiate from this point, and, of course, produce a much sharper shadow of the object being photographed than when radiating from the extended luminous patch on the glass of the tube which has hitherto generally been used. The cut shows a section of the "focus" tube. The cathode plate, K, is a concave disk of aluminum which focuses the cathode rays at a point near the center of the bulb. The anode plate, A, is a small piece of platinum foil placed at an angle a short distance beyond the focus of the cathode rays. Curiously enough, the cathode rays do not cross like rays of light at the focal point, but behave rather like a number of fluid jets coalescing at the focal point, and proceeding thence onward as a solid parallel jet. The point where the rays impinge on the platinum still retains its small dimensions, though the plate is placed some distance beyond the focal point.

Platinum is known to be one of the most opaque substances for the cathode rays, and thus very little of the radiation passes through the platinum foil. The greater part of the radiation is absorbed by the platinum, and given out as X rays from the luminous point, by a kind of diffuse reflection. The anode plate, A, being set at angle, the best part of the radiation is directed downward through the sides of the bulb, where it can be conveniently utilized to produce the photograph in the usual way. The tube, H, through which the bulb is exhausted, is shaped so as to permit the tube to be fixed in a stand at the required height. The anode and cathode plates are connected to the terminals



of the induction coil by platinum wires fused through the glass.

The great reduction in the length of exposure obtained by this tube will undoubtedly soon enable the X rays to be utilized for the examination of the thicker parts of the body, as, for example, in abdominal surgery. It is highly probable that, by the use of special photographic plates, and phosphorescent screens, the time of exposure may soon be still further reduced.

We are indebted to the Electrical Review, of London, for the above particulars.

International Electric Railway Prize Problem.

The president of the commission in charge of the design and construction of the mountain railway in Switzerland to the top of the snow-clad Jungfrau Mountain gives the following information concerning the prizes offered for the solution of certain problems involved in the construction of this road.

The total sum of the prize offered is 30,000 francs ($6,000) for the best solution of a number of questions which are involved in the construction and operation of this road. The chief points involved are the following:

1. In the laying out of the road; the profile of the tunnel; the roadbed and elevated structures; the rails, rack, switches and crossings. The best system for transmitting the electrical energy; protecting against interruption by atmospheric conditions; rolling stock; project for the construction of the station and restaurant at the Eiger Glacier station; design of the station (presumably near the top), which is to be bored out of the solid rock; an elevator of a height of 100 m. and 8 m. in diameter, to the top of the mountain.

2. In the construction of the road, methods of boring the tunnel, and all problems connected therewith.

3. In the operation of the road, precautions and devices for assuring continuous operation and preventing interruptions. Method of lighting and heating the tunnels, cars and stations.

Solutions of one or more of these questions may be offered by single individuals or by several collectively. Solutions of other questions not enumerated, which are deemed of importance in the construction of this road, will also be accepted. The scientific commission will decide on the value of the answers, and their results will be published. By offering the prizes the company reserves the right to adopt the solutions for which prizes are offered, without further cost, on this road only. Solutions which do not receive prizes will be returned.

The following information is added: The maximum grade is 25 per cent, the gage 1 meter, the smallest radius 100 meters, the smallest "ausrundungsradius" 500 meters, the greatest width of rolling stock 2·50 meters, and the greatest height 3 meters, the allowable speed 7 to 10 kilometers per hour. The water power for generating the current amounts to about 5,000 horse power, and will be taken from the two Luetchinen; from the turbine to the beginning of the road the distance is about 8 kilometers, and from there to the beginning of the tunnel, 2·5 kilometers; the tunnel has a length of 10 kilometers.

Applicants for prizes should send drawings or models, if necessary, as also estimates of cost. Prizes will be received up to August 1, 1896. Further information may be obtained from the Bureau der Jungfraubahn, Bahnhofstrasse 10, Zurich, Switzerland.

Progress of Scientific Work.

A year or two ago attention was called to the prediction of an eminent authority that we were entering upon a period of scientific activity that would far transcend any previous experience. The most indifferent observer cannot fail to be amazed at the manner in which this prophecy is being fulfilled. Chemists are astonished to find that the long familiar atmosphere contains a large proportion of a substance hitherto unknown—the strange and inert argon; and helium, so long known in the spectrum of the sun, is discovered as a terrestrial element. With the liquefaction of air and hydrogen we are introduced to a new chemistry of cold. The development of the electric furnace brings great possibilities in the reduction of certain metals, and among its remarkable products yields calcium carbide, the source of acetylene, which is the first hydrocarbon to be produced artificially on a large scale, and a revolutionary achievement in chemical synthesis. Most surprising of all is the new form of radiant energy. Eager students everywhere have quickly begun experimenting with the mysterious X rays, and in a few days we are given the new art of "shadowgraphy," which promises, among other marvels, that the sick can have their diseased organs brought to view, while the curious can have their skeletons photographed while they wait. The details of this new photography are being improved daily. Other epoch-making discoveries are almost grasped, and it is clear that, with so many roads opened to peaceful conquest, our end-of-the-century days leave no time for demoralizing wars over political boundaries.—Mining.

The Deepest Shaft in the World.

At the greatest depth ever attained by miners in the history of the world, the mines in the vertical Red Jacket shaft of the Calumet & Hecla copper mine have recently stopped sinking at a depth of 4,900 feet, as this is the required depth necessary for this company to reach the limit of its underground territory. Bored wells have been carried down to a greater depth, but the Red Jacket shaft is the largest and best constructed mining shaft in the world. Its inside dimensions are 14×22½ feet, divided into six compartments and timbered throughout with pine. The shaft was started in the fall of 1880. The new shaft rock house, which will be built of iron and will be made fireproof throughout, is the only part of the work necessary to put this deep shaft in commission, as the hoisting machinery, which consists of two pair of triple expansion engines of 3,000 horse power per pair, and will hoist a load of ten tons 60 feet per second, was planned and put in place while the sinking of the shaft was going on.

The Untruthfulness of Morphinomaniacs.

The mental and moral destruction which occurs in a victim to the morphia habit is a fact which unfortunately has been only too frequently demonstrated. This point has led to some discussion respecting the expediency of rejecting the testimony in a court of law of those who are known to be addicted to the use of morphia. One authority has even gone so far as to say, "I would not believe a man who is a victim of the morphia habit on oath." No doubt the moral obliquity as to truthfulness present in such a person would be perfectly uncontrollable, under any circumstances, and unrestrained, even although he had sworn to tell the truth. But before coming to any definite decision upon the question of receiving or rejecting the evidence of such a witness, it would first of all be only expedient to determine what constitutes a person whose mental and moral capacities have been tainted by the use of morphia.—Med. Press and Circular.

A BILL is before the Ohio legislature claiming bicycles as vehicles to bring them within the vehicle taxation laws.

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THE EDISON X RAY EXPERIMENTS, APPARATUS AND FLUOROSCOPE.

The laboratory of Thomas Alva Edison has been the scene of active work during the present period of interest in the Roentgen discovery. Mr. Edison early began his investigations on the subject, feeling that he needed but one or two weeks to determine the controlling factors of success. As guide he had Roentgen's original paper, and his path seemed short and clear. Now, after two months' active work, his goal is reached, and he has succeeded in devising a simple apparatus by means of which the skeleton of the limbs may be observed as in a photograph.

His work has taken two principal directions: one the perfecting of the Crookes tube; the other the production of an apparatus, the fluoroscope, for enabling the X ray phenomena to be observed directly without the intermediation of photography. After endless trials with different glasses, shapes, and sizes of Crookes tubes and disposition of electrodes, he has adopted as final shape an ellipsoidal tube about five inches long, shown in Fig. 1. At each end are internal disk electrodes of aluminum slightly inclined to each other. The outside of the tube ends are coated with metallic caps, forming external electrodes. Of the effect of such a tube, about 60 per cent is due to the internal electrodes and about 40 per cent to the external ones. He next found that at a particular point of exhaustion the effect was best. This point is when the band spectrum begins to disappear and the spectrum becomes continuous. Accordingly, he has adopted the system of using a tube sealed at the ends and with a short tube entering its side. The latter enables connection to be made with an air pump of the Geissler or Sprengel type. After connection with the pump, about half an hour's exhaustion gives the vacuum best for development of the X rays, the object being to hold the exhaustion at the point of maximum during the period of observation.

One very curious tube experimented with and shown in Fig. 1 had internal wire electrodes only, and these were sealed into a rod or tube of glass extending from end to end of the tube. This tube gave good X ray effects, although the electrodes were embedded in glass. In another experiment, shown in the same cut, a metallic tube half an inch in diameter and two feet long was provided with a metallic shield at one end. The shield end was placed against a plate holder containing a photographic plate. The other end was pointed at the Crookes tube. It was found that whatever part of the tube the testing apparatus was pointed at, the X rays produced the image of the aperture through the long steel tube. This showed that they are radiated in all directions from an active tube.

Combustion tube glass was chosen as material for the Crookes tube, which is blown as thin as possible. The second element of the problem reached was the fluorescent screen apparatus, its construction and fluorescing material.

Mr. Edison was early convinced of the importance of the visual as against the photographic method of observation. Dissatisfied with the barium salt used by Roentgen, he bent all his energies to the development of a new apparatus which should be superior in construction and fluorescent material to any yet suggested. During his researches he examined some eighteen hundred chemicals. To test them he used a pasteboard cylindrical box, about two inches in diameter and four inches long, with a sighting hole in its bottom. His assistant started at his laboratory shelves and brought him, one by one, every chemical in the place. Some of the chemical to be tested was placed in the inverted cover of the box, the inverted box was put in place over it, and Mr. Edison looked through the eyehole in the bottom down toward an excited Crookes tube. For four days and nights the tests went on, many salts were laid aside as fluorescent, but calcium tungstate proved incomparably the best—it is about eight times as powerful as platinocyanide of barium.

This salt is made by fusing together a mixture of sodium chloride, sodium tungstate and calcium chloride. The calcium takes up the tungstic acid, sodium chloride being the other product of the double decomposition. Treatment with water dissolves out the sodium chloride and leaves the insoluble crystals of calcium tungstate. These are dried and sifted. Such as go through a No. 30 mesh are the coarsest used. The largest are distributed over a pasteboard screen coated with wet celluloid varnish, then finer ones are added until a smooth, uniform surface results. The screen is mounted at the end of a sighting box of pasteboard, with the prepared surface inside. The other end of the box is shaped to fit the contour of the face around the eyes.

On holding the hand over the end of such a box, if X rays fall upon it, the surface will fluoresce, except where the shadows due to the Roentgen effect are produced, with the same perfect detail that is seen in the best of the Roentgen photographs. One grain of tungstate per square inch of screen is required for the coating.

The cut (Fig. 2) shows the apparatus now being designed for practical use. After what has been said it is easily understood. The Crookes tube is contained in the wooden box. On it the patient rests his hand or arm, and the physician, with fluoroscope strapped to his head, observes the condition of the bones. An

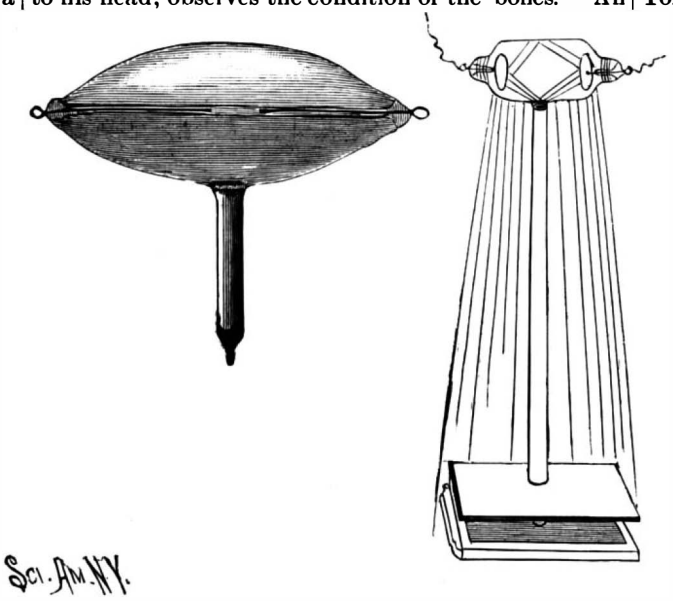

Fig. 1.—EDISON'S EXPERIMENTS WITH X RAY PHENOMENA.

induction coil with rotary circuit breaker actuated by a motor, and with Elihu Thomson's air blast to blow out the arcs, is to be part of the plant. Mr. Edison finds that a condenser impairs the effect. The sudden break produced by the circuit breaker and air blast gives the best effect.

The tube with which the writer's observations were made was placed by Mr. Edison upon his air pump. Gradually on trial fluorescence began to appear as the vacuum increased, and occasional observations were made with a pocket spectroscope to note the period of disappearance of the bands. At last the X rays began to be radiated. The fluoroscope was applied to the eyes, and its base appeared brightly illuminated. The hand was placed over it, and a shadow was produced. Every minute the effect improved until at last, almost with startling suddenness, the bones appeared in perfect outline, the flesh having almost entirely disappeared.

The lower arm, held over the end of the fluoroscope, showed the space between the two osseous members, the radius and ulna. A purse experimented with disclosed its metallic jaws and coins within it. A thick board placed between the object and the instrument

Fig. 2.—EDISON'S SURGEON'S X RAY APPARATUS.

had but little effect in dimming the image. The importance of this apparatus to the surgeon cannot be over-estimated. It will give him an instant diagnosis of his case. The photographic method involves long exposure, in itself an evil, followed by the slow development and drying of the plate, and, worst of all, the uncertainty of getting any result whatever. The fluoroscope tells the story at once. Outside of the surgeon's practice, it will be of great use to all experimenters with X rays, as giving them an instant valuation of their tubes and of their excitation.

The Cosmopolitan Horseless Carriage Competition.

In our issue of February 15, 1896, it was announced that a competition of horseless carriages would be held under the auspices of the Cosmopolitan Magazine, on the 30th of May, for a prize of $3,000. The indications are that the competition will be very successful. The gentlemen who have consented to act as judges are as follows: General Nelson A. Miles, United States Army; William T. Craighill, Chief of Engineers, United States Army; Mr. H. Walter Webb, Vice President, New York Central and Hudson River Railroad Company; and Mr. John Jacob Astor. It was at first decided that the award should be made from the finding of the judges upon the following points: Speed, 50; simplicity and durability of construction, 25; ease in operation and safety, 15; cost, 10. It was, however, considered wise to revise the conditions of the competition as it was thought that too large a percentage was given to speed. The awards will now be made upon the following points, the maximum being 100: speed, 35; simplicity of construction and durability, 30; ease in operating and safety, 25; cost, 10. The route selected for the competition is about twenty-six miles in length, thus requiring a total run of fifty-two miles. It passes along Broadway to Central Park, through Central Park to Washington Bridge, thence to Yonkers, where the course will include five miles of asphalt pavements, then following the country Broadway to Irvington, paralleling the Hudson the entire route and passing through one of the most beautiful regions of America. The roadway over which the trial will be made would be considered fine even in France.

A PAVEMENT used in Vienna consists of granulated cork mixed with mineral asphalt and other cohesive substances, compressed into blocks of suitable size and form. Among the numerous advantages set forth in its behalf are cleanliness, noiselessness, durability, elasticity, freedom from slipperiness, whether wet or dry, and moderate cost. Unlike wood, too, it is non-absorbent, and consequently inodorous. It presents the minimum resistance to traction, and, being elastic under passing loads, does away with the vibration caused by heavy teaming. The blocks are embedded in tar, and rest upon a concrete base six inches thick. When taken up for examination they have exhibited, when compared with new ones, a reduced thickness by wear of less than one-eighth inch—this in the case of a section of a London street leading to the Great Eastern Railway station, subjected to continuous heavy traffic, the blocks having been in use nearly two years.

A Mountain of Solid Granite.

BY WALFRED WILSON.

In Burnet County, Texas, rising abruptly out of the level prairie, is a mountain of solid granite as smooth and bald as a negro's head without hair. It covers an area of seventy-five acres and rises two hundred feet above the surrounding surface. It contains, above the level of the base, one hundred million cubic feet of granite, available to the quarryman without a foot of dirt or other matter to be stripped off. The value of granite at the quarry in Eastern States is twenty-five cents per cubic foot. The granite in this mountain, at the nominal value of one cent per cubic foot, would be a million dollars for the amount of stone above the level of its base. The size of the stones which may be here quarried and moved is limited only by the capacity of machinery for moving them. Tests made by Col. D. W. Flager, of the United States Army, at the Arsenal, Rock Island, Ill., and certified by him to the Texas capital commissioners, show the crushing strength of the granite from this mountain to be 11,891 pounds to the square inch, while the ratio of absorption of water to the weight of stone tested was only 0·00094 after soaking forty-three hours. Its specific gravity is 2·8249. The granite from this mountain is pronounced equal to the celebrated Scotch granite and it contains comparatively no iron or other foreign matter. It is stripped by nature and lies in regular strata, is very easily quarried and cut, and assumes a magnificent polish. In color it varies from the red or rose colored stone, of which the State capitol is constructed, to a light gray, with various intermediate shades. Granite has been taken from this mountain for the capitol building and dam at Austin, the jetty works at Galveston Harbor and mouth of Brazos River, and the government building at Kansas City, without having any perceptible effect upon its appearance. At a distance it looks as if it had never been touched.

A TAX on vehicles, whether kept for hire or personal use, is imposed in many Western communities, on the principle that their owners should pay specially for the use of the highway, and the Indiana Supreme Court has decided that such a tax may be collected from non-residents who drive over the streets of a city.

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RECENTLY PATENTED INVENTIONS.

Engineering.

CENTER BLAST PIPE FOR FURNACES.—Charles Johnson, Rutland, Vt. This is an improvement upon a formerly patented invention of the same inventor, designed to insure an equal distribution of the air through a tuyere opening into the heated fuel in the stack, and to permit of readily repairing burned parts of the pipe. The original invention was illustrated and described in the SCIENTIFIC AMERICAN of July 13, 1895. A series of removable rings loosely surround the pipe, which is made in sections, with tuyere openings between them, and the pipe has a conical cap, on the base of which is an annular flange holding a protecting ring.

VAPOR OR STEAM CONDENSER.—Albert Hoberecht, Ensenada, Mexico. This condenser comprises a casing having an offtake or stack at its upper end and a steam inlet at its lower end, there being in its sides air inlets connected with cold air supply pipes, while horizontal baffle plates within the casing direct the ascending steam and vapor past the cold air jets. The amount of cold air admitted may be regulated by dampers, and the water of condensation is passed to an outlet at the bottom of the casing.

SURFACE CONDENSING TUBE.—This is another invention of the same inventor, providing a condensing tube having internal and external condensing surfaces of a material which will conduct heat quickly and of a minimum thickness, whereby the air will have increased cooling action on the outside of the outer tube and the inside of the inner tube. The inside and outside faces of the tubes are strengthened and reinforced by spiral spring wire coils, and both the wires and tubes are strengthened by spiders or transverse supports, so that the tubes will have strength to withstand vacuum and pressure.

Railway Appliances.

CAR FENDER.—Augustin M. Chavez, Mexico, Mexico. This fender is designed to rescue a person lying on the ground as well as one standing up in the path of a moving car, being, it is claimed, thoroughly antomatic in its action, and of simple, durable and inexpensive construction. It is made in two scoop sections adapted to balance one another, and the forward or receiving section being only slightly above the surface of the ground. Covering both sections is a bed of netting, in which one struck by the fender is received, without liability to injury.

RAILROAD TIE PLATE.—Alexander B. B. Harris, Bristol, Tenn. This is a flat plate having tongues or split extensions adjacent to the spike holes, the tongues having projecting toes or flanges adapted to be expanded or forced outwardly and embedded in the tie by the thrust of the spike. The plates are designed to prevent the wear of the tie beneath the rail, for which a solid, firm, and secure anchorage is formed.

CAR WHEEL AND TRACK.—Christian W. Flint, Port Townsend, Washington. To permit a train to run around curves with great speed, without danger of deralling and without inclining the tracks, this invention provides for having two rails for such sections, one rail having its tread higher than the other, and the elevated tread being beveled downward toward the other rail, the wheel also having two treads of different diameters, with a dividing flange between the treads. The gage of the rails on a curve will be about half an inch wider than on a straight track, to prevent the flange of the outer wheel binding on the head of the outer rail.

Electrical.

ELECTRIC LAMP.—Charles E. Quimby, New York City. This invention provides for an electric lamp arranged singly for attachment over one eye, or for a pair of lamps to be mounted on a spectacle frame, the incandescent filament occupying an annular globe in a suitable casing, the globe having an internal diameter of three-eighths to half an inch. The ends of the incandescent filament are attached to wires sealed in the glass, and insulated wires furnishing the current are connected with the lamp by binding screws, the lamp being attached by a universal joint to a band passing around the head of the user.

Mechanical.

CARPENTERS' PLANE OILER.—Theodore M. Anderson, New Whatcom, Washington. To reduce friction between the plane and the wood being dressed this inventor provides a lubricating attachment according to which the plane has a base portion with parallel and perpendicular sides between which is a block, a bit mounted between the sides being supported by the block, in which is an oil chamber, a wick in which is adapted to extend to the under side of the stock.

GRINDING MILL.—George C. Ahrens, Gillespie, Ill. This is an improved mill for grinding coffee, spices, cereals, etc., and is designed to grind large quantities without much exertion. It has crushing and grinding surfaces arranged one above the other, the crushing burr forming a feed for the grinding burr, and the stem of one of the burrs being hollow to receive the stem of the other burr. The stems are locked together in unison and are operated by a handle.

BALL BEARING.—Frederick C. Avery, Chicago, Ill. This inventor has devised a means of protecting a ball bearing against dust or grit, and a bearing that will retain the balls when the cone is removed, the oil being applied directly on the balls, simplifying and cheapening the construction without any addition in weight. The usual flange of the cone is cut away and its outer portion is made cylindrical and of less diameter than the shell or the ball holder, the space being made use of for a special form of dust protector, combined with which is an oil receiver.

Miscellaneous.

AIR SHIP.—Manoel V. Coutinho, Para, Brazil. This invention comprises a balloon with side flange extending around the bow to serve as an aeroplane, its upper and lower portions forming substantially two conical sections, and a sleeve in the central portion having a flexible connection to engage halyards, The apparatus is designed to be navigated by an electric or other motor, side propellers forcing the car up or down or forward or back, and rendering its steering easy.

MULTIPLE PROJECTILE.—Larence A. Johnson, San Francisco, Cal. This is a projectile more especially designed for long range use, and is made in three or more sections which may be separated from each other and arranged to form a projectile to be fired from cannon in the usual manner. The separable sections of the body are each formed with a bore adapted to contain a charge, the sections each having a shank fitting in the bore of the next section, dowel pins engaging recesses in the opposing section, and the sections having interlocking external rings.

SLED PROPELLER.—Willis A. Bradley, Gem, Idaho. This invention provides a steam-propelled ice boat, which may also be used as an engine of a train of boats to be drawn over the ice. It comprises a frame having adjustably mounted and independent runners at each side and a steering runner at one end, while a motor operates a spiked drive wheel. The boat may be guided and controlled by levers and appliances in the pilot house.

DUMP WAGON.—George Vaughan, Salt Lake City, Utah. The bottom of the body of this wagon is composed of a number of drop doors which may be opened by the driver by turning a crank, the arrangement being such that the entire load may be dumped in a pile, or it may be distributed over a given area, the driver not having to leave his seat. The improvement does not interfere with the carrying capacity of the wagon.

VEHICLE WHEEL BEARING.—John Pettinger, Santa Barbara, Cal. The hub box, according to this improvement, has an integral spindle adapted to engage a tubular axle, reducing the friction of the bearing parts to a minimum, while the wheel hub, by reason of the long spindle, easily maintains its proper relation to the axle, so that wabbling is prevented and the wheel is held to run true. Abundant lubricant may be passed between the spindle and the tubular end of the axle, obviating the necessity of frequent lubrication.

EXTRACTING GOLD FROM SOLUTIONS.—Giles O. Pearce, Colorado City, Col. To extract and recover gold and platinum from aqueous solutions, particularly sea water, this inventor provides for passing the solutions through a mass of vegetable carbon having associated with it sulphate of iron, oxalic acid and tartaric acid, to secure the reductions and depositions of the metals on the carbon, which is afterward burned, reducing and melting the metals into a mass.

MACHINE FOR UNDOING CIGARETTES.—Jose M. Urgelles, Guyaquil, Ecuador. For opening or undoing cigarettes which are defective, that the tobacco may be used again while the wrappers go to waste, this inventor has devised a machine in which a movable box is arranged to reciprocate back and forth between a feed device and a cutter. the defective cigarettes falling from a hopper upon the bottom of the box, and being carried singly into the path of cutter blades, by which they are torn open and fall into a receptacle below.

COPY HOLDER.—George E. Smith and Frank P. Garrison, Westwood, Ohio. This device comprises a standard on which is movable a runner with horizontally swinging arm carrying a pivoted copy-holding frame which may be swung to bring it into any desired position. A spring-actuated clamping bar of the copyholding frame is also adapted to hold books, the bar being arranged to bear on each side of an open book. The device is very simple and inexpensive, readily adjustable, and adapted to be securely fastened to a table or desk.

FLY TRAP.—James S. Shumate and Henry W. Bartels, Houck, Mo. This is a device adapted for attachment to a curtain, so that when the curtain is drawn over a window light is admitted only through the trap, thus attracting the flies to enter it. Means are provided for regulating the amount of air to be passed through the trap, and the device is very simple and inexpensive.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

COMPUTATION RULES AND LOGARITHMS, WITH TABLES OF OTHER USEFUL FUNCTIONS. By Silas W. Holman. New York and London: Macmillan & Company. 1896. Pp. xlv, 73. Price $1.

Of those who use logarithms, very many imperfectly understand the full use to be made of them. There is much in the science of computation that is not always fully grasped even by those who have long calculations to make, and to such persons the class of works giving computation rules are particularly valnable. They should be in the hands of all scientific students. These columns are admirably printed so as to save the strain on the eyes incident, and unavoidably so, to the use of such tables. A very nice feature of the book is found in the last pages, where a quantity of logarithmic constants, mathematical and mechanical, are given, so that logarithms can be directly applied to the most generally used calculations of mechanics.

A TREATISE ON THE MANUFACTURE OF SOAP AND CANDLES, LUBRICANTS, AND GLYCERIN. By William Lant Carpenter. Second edition. Revised and enlarged by Henry Leask. London: E. & F. N. Spon. New York: Spon & Chamberlain. 1895. Pp. xii, 446. Price $4.

An excellent idea of the extent of this work and the fullness of the treatment accorded to its subject can be gained from the twenty-two page index, and it really is an example to technical publishers as an illustration of how technical works should be indexed. Everything touching the subject, from A to Z, seems here to be covered. Numerous illustrations are contained, and the subjects of analysis and examination of materials are excellently treated. Thus we notice, among other features, description of new apparatus for the determination of specific gravity and melting points, with illustrations and descriptions of their use in the text. The book is one that should be on the shelves of the libraries of all soap manufacturers. We cannot but believe that the technology of one subject will be of assistance in the study of many others. One chapter is devoted to the bibliography, and the meagerness of the list would seem to indicate how little trodden is the field which is open for such a work as the one under consideration.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6803) O. H. F. asks: By what electrical arrangement can I heat to 103 degrees Fah. a box 3 feet square by 2 feet high? Am using gas now, but with poor result. A. Use a coil of iron or German silver wire if you have an incandescent system to draw on. For thermostats see our SUPPLEMENT, Nos. 848, 902, 959.

(6804) H. M. H. asks: Can you give me a number of good and simple receipts for an inexpensive, colorless gum, for labels? A. 1. Tragacanth, 1 ounce; gum arabic, 4 ounces; water, 1 pint. Dissolve, strain, and add thymol, 14 grains; glycerine, 4 ounces; and water to make 2 pints. Shake or stir before using it. 2. Rye flour, 4 ounces; alum, ½ ounce; water, 8 ounces. Rub to a smooth paste, pour into a pint of boiling water, heat until thick, and finally add glycerine, 1 ounce, and oil cloves, 30 drops. 3. Rye flour, 4 ounces; water, 1 pint. Mix, strain, add nitric acid, 1 drachm, heat until thickened, and finally add carbolic acid, 10 minims; oil of cloves, 10 minims; and glycerine, 1 ounce. 4. Dextrin, 8 parts; water, 10 parts; acetic acid, 2 parts. Mix to a smooth paste and add alcohol, 2 parts. This is suitable for bottles of wood, but not for tin, for which the first three are likewise adapted. 5. A paste very similar to 3, but omitting nitric acid and glycerine, is also recommended by Dr. H. T. Cummings.

(6805) P. A. J. asks: 1. Where can the calcium carbide be obtained A. You can get calcium carbide from the dealers in scientific and mechanical supplies. 2. Would like to get a good recipe for a frosting on a skylight. It must look neat when dry and not wash off easily. A. Sandarac, 18 parts; mastic, 4 parts; ether, 200 parts; benzol, 80 to 100 parts; or, for an imitation ground glass that steam will not destroy, put a piece of putty in muslin, twist the fabric tight and tie it into the shape of a pad; well clean the glass first, and then pat it over. The putty will exude sufficiently through the muslin to render the stain opaque. Let it dry hard and then varnish. If a pattern is required, cut it out in paper as a stencil; place it so as not to slip and proceed as above, removing the stencil when finished. If there should be any objection to the existence of the clear spaces, cover with slightly opaque varnish. 3. In order to increase an electric spark, what should I do—increase the number of windings on spark coil or use more battery? A. Increase the number of windings and the size of core of the coil. More battery will also increase the spark. In the SCIENTIFIC AMERICAN, vol. 74, No. 2, spark coil apparatus for lighting gas is described.

(6806) R. A. R. asks: 1. Can I make a coil to give a 3 or 4 inch spark, using No. 16 wire for the primary and for the secondary No. 36 cotton covered wire and immersing the whole coil in paraffine or other oil, first heating so it will penetrate? I would make the interrupter independent. Do you think the oil insulation would stand if I made the coil long and thin, rather than short and thick, and would I get the same effect? A. Our SUPPLEMENT, No. 160, describes a coil rather smaller than the one you specify, but it gives a good model to go by A coil such as you describe is large for an amateur to make. See also our SUPPLEMENT, No. 229, for a larger coil. Nothing is better than oil as an insulator, as it is self-repairing. You may make the coil long. Wind the secondary in short sections. 2. What is a Tesla coil? A. Tesla uses a liquid dielectric in his coil. It is adapted for high potential work. 3. I want to tap the incandescent circuit alternating of 54 volts, using a step-up transformer to get 1,000 volts, and then increase the voltage so as to get as high as possible voltage and lowest amperage, getting the luminous vacuum effects. How shall I proceed? A. Use converters, establishing the desired ratio between the number of turns in primary and secondary. Diminish the size of wire to correspond with the reduced amperage. 4. Where can I get Sir William Thomson's table for computing voltage by the spark length? A. Allow 10,000 volts per one-tenth inch.

(6807) W. W. K. asks: 1. Are the carbon plates used in batteries made of carbon which has first been ground and then moulded into the plates? If so, please describe the process, so that I may be able to make them. A. They are moulded. For description of the identical manufacture of electric light carbons, we refer you to our SUPPLEMENT, No. 626. 2. What is the best way to melt gutta percha when making the compound for rendering wooden cells acidproof, given in SCIENTIFIC AMERICAN of March 7, 1896, ninth question of questioner 6746. A. Do it over a carefully regulated source of heat. 3. About how many volts does an induction coil give when the spark is one-quarter inch long? A. See last answer in above query. 4. How much zinc surface is required for each ampere in a Grenet battery? A. No fixed area can be cited, as it constantly varies. Allow one to three square inches of immersed plate. 5. Will you please give a table of wire resistances, etc.? A. We refer you to Sloane's "Arithmetic of Electricity" for a wiring table.

(6808) J. L. writes: How many volts are there required to light a 16 candle lamp and also what surface should I give to accumulators and how many batteries must I have to charge them? A. A 16 candle power lamp is made for 20 to 120 volts, or even higher, according to requirements. In a storage battery allow 5 amperes for each square foot of positive plate and 2 volts for each cell. It is not advisable to make your own batteries. For storage battery work use the 20 volt lamps. They consume 2 to 2½ amperes each.

(6809) M. A. L. asks: Will you give directions through Notes and Queries for making the bellows for a photographic camera, also the material used for same? A. In our SUPPLEMENT, No. 625, we give an elaborate description with full illustrations of how to make one, to which we refer you.

(6810) C. L. C. asks: What is the average horse power of a modern passenger locomotive? A. The largest locomotives can develop 1,600 horse power. The average work may be stated at about 1,000 horse power with full trains, on up grades.

(6811) X. Y. Z. writes: 1. On a barometer just purchased I notice that the vernier does not correspond to the inch spaces on the scale, and, on investigation, I find that in all the illustrations of the vernier in cyclopedias, etc., it is always made to conform to a longer or shorter space than the spaces on the scale. In our own barometer the inches on the scale are divided into twentieths, while the vernier is divided into twenty-fifths, and "evens up" with the scale at $\frac{24}{25}$ of an inch. Why is it not made so that the inch mark will be the place where the scale and the vernier agree? As it is now, it seems to me that the reading of the vernier will not have as its unit the inch, but that it will have $1\frac{1}{25}$ inches as its unit. A. The vernier, as you describe it, divides each $\frac{1}{20}$ of an inch into 25 parts; the reading, in other words, is to the $\frac{1}{500}$ inch, and by eye you can get it to $\frac{1}{1000}$ inch. The vernier divisions have no reference to the inch, but to the $\frac{1}{20}$ inch. The vernier might just as well have 50 divisions for 49 of the scale divisions, or any other ratio (the inch is not involved, but the fractional or small divisions are)—in your case $\frac{1}{20}$ inch. 2. What mathematical principle is involved in the following examples? I am able to secure the answers, but cannot devise y satisfactory rule or method for solving either one. (a) A's age is to B's as 1 to 3, but in 20 years their ages will be as 1 to 2. Required their ages (20 and 60). (b) A courier rides from the rear to the front and back of an army fifty miles long while the army moves forward 50 miles. How far does he travel? (About 120·711 miles.) A. Algebra gives the readiest solutions. (a) Call A's age x and B's age y. We then have

$$3x=y; \quad (1)$$
$$2(x+20)=y+20; \quad (2)$$
$$x=20$$
$$y=60 \quad \text{answer.}$$

(b) Assume rate of army's march to be 1 mile per hour. Let x=courier's rate; y=distance traversed by army when courier reaches their front and turns. The time occupied by the courier will then be 50 hours. He will ride forward a distance of 50+y, will turn and ride back a distance y. The distance he rides can be expressed by 50x or by 50+2 y. This gives

$$50+2y=50x. \quad (1)$$

While he rides forward 50+y miles at x miles per hour, the army moves y miles at 1 mile per hour. This gives

$$\frac{50+y}{x}=y \quad (2)$$

Solving, we get $y=\sqrt{1250}=35·355+$
Substituting in (1) we find $50x=120·711+$.

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March 24, 1896,

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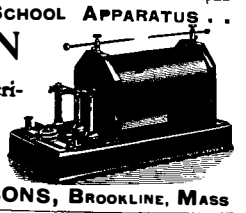

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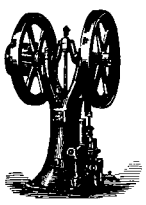

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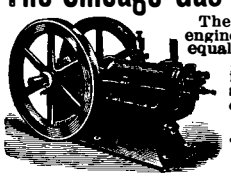

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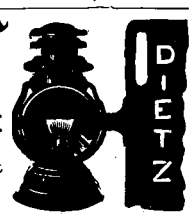

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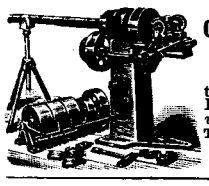

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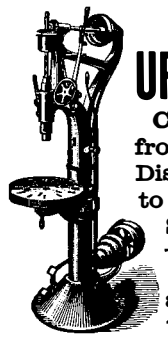

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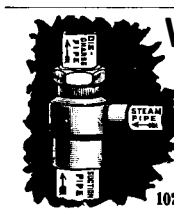

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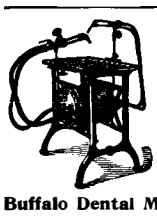

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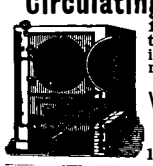

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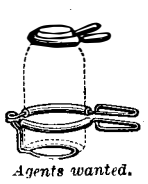

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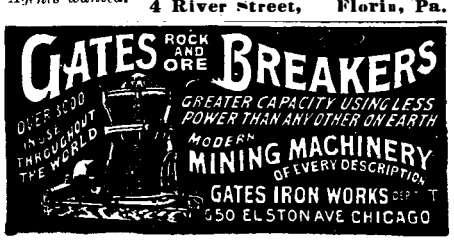
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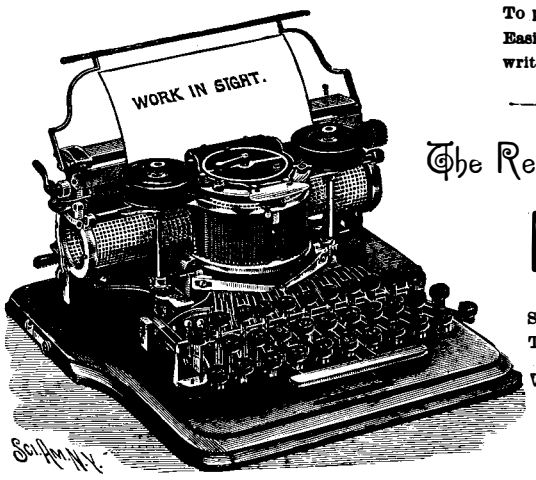

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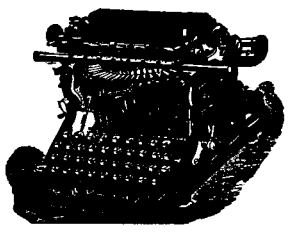

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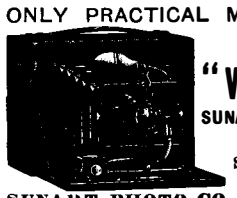

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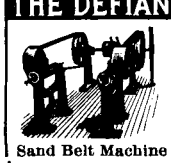

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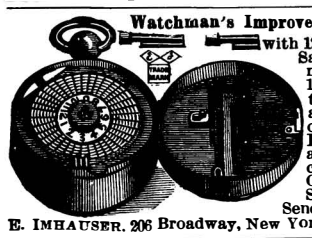

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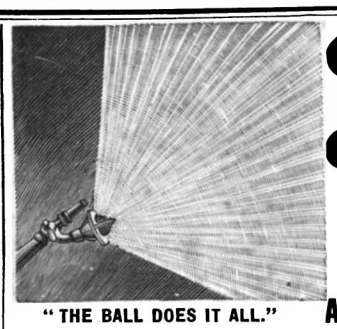

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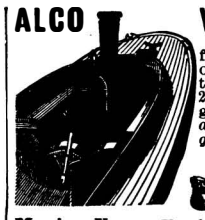

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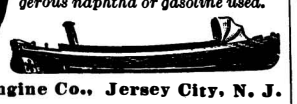

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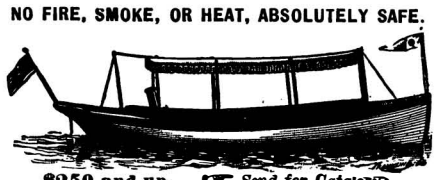

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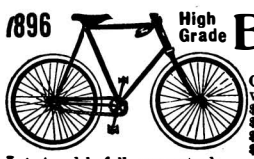
1896  **High Grade Bicycles**
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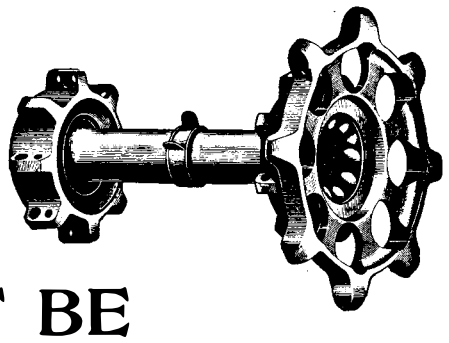

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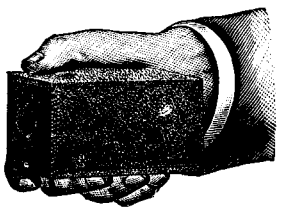

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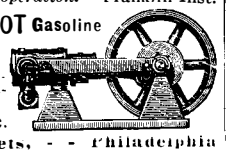

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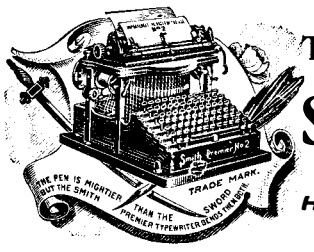

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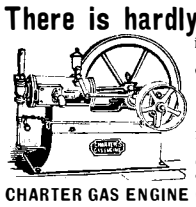

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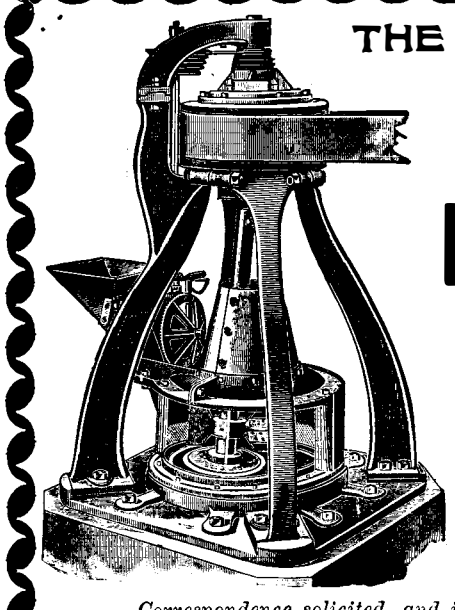

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